FRONTLINE RADIOGRAPHIC HUMAN CAPITAL DEVELOPMENT – a Case of Zambia and Way Forward

By

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DECLARATION

I Foster Munsanje declare that this thesis titled *'Frontline Radiographic Human Capital: a Case of Zambia and Way Forward'* represents my own work. It has never been submitted at any other university or institution for qualification. The sources of information utilized in this work have been acknowledged in the reference list.

The thesis is submitted in compliance with the requirement for Degree of Doctor of Technology: Radiography, at Durban University of Technology.

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DEDICATION

This work is dedicated to the memory of my departed father Mr. Ivan Munsanje, fellow fighters of any form of poverty – material, mental, spiritual – and our sympathisers.

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ABSTRACT

The shortage of radiologists in Zambia has persistently made the provision of equitable access to optimum radiological services unattainable in the current radiological service delivery system, while equity in distribution of cost-effective and quality healthcare service as closer to the community as possible is at the core of Zambia's vision in the National Health Strategic Plan. This vision is maintained in Zambia's Sixth National Development Plan, for the period 2011 to 2015. The number of radiologists as low as three radiologists, for a population of thirteen million people, makes the possibility of ever providing optimum radiological services equitably accessible to the community unattainable, without launching and upholding a precise remedial intervention.

The purpose of the study was to develop a framework for sustainable radiographic human capital developmental guidelines embracing advanced radiographic practice and optimum radiological services, with special focus on hospitals without radiologists. The objectives were to: a) analyse the existing radiographic services and/or practices in rural Zambian hospitals without radiologists; b) examine the views of radiographers, physicians, and patients in hospitals without radiologists, regarding adequacy of radiological service delivery; c) determine desirable competencies for frontline radiographers in comprehensive radiological service delivery, as well as the benefits of such competencies to the community and the health service facilities; d) analyse the healthcare managements' expectations regarding frontline radiographers' capabilities in rendering comprehensive radiological services in healthcare settings without the radiologists, e) formulate, implement, and evaluate a training programme for radiographers for comprehensive radiological services; with specific references to client (physician and patient) satisfaction and radiographic competencies; and (f) develop a framework for human capital development for frontline radiographers in providing comprehensive radiological services.

The Accenture Human Capital Development Framework (AHCDF) was employed as the theoretical framework to link all key aspects of the inquiry (Thomas, Cheese and Benton, 2003). An Action Research design was used involving multidisciplinary participation, including patients, in the five cyclical phases of the Action Research design; diagnosing, planning, acting, evaluating, and specifying learning. The route of knowledge generation and

application was guided by retroductive or abductive cyclical logical process. The interviews, document analysis, and questionnaires were applied to obtain data, whereas a designed training programme for frontline radiographers was piloted and evaluated within this study. The study's data management and analysis were largely by qualitative methods, though quantitative aspects involving percentages as in descriptive statistics were also involved where appropriate.

The discussion, integrates the research findings under appropriate themes of the theoretical framework. An investment perspective in AHCDF is linked to ways of investing in radiographers' education and training towards extended roles is discussed. The radiographers' extended roles are seen as a catalyst to desirable radiological technology, radiological service designs, and corresponding radiological service outcome. The benefit of this proposed investment is seen as promoting equitable access to radiological services, with averted or reduced costs ascribed to referrals of patients among hospitals. Consequently, incomes of households and healthcare institutions would be preserved for poverty reduction by reduced referral-related costs. The researcher-devised frontline radiographic human capital developmental (FRHCD) conceptual framework is developed and a way forward recommended.

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CHAPTER 1
INTRODUCTION

This Chapter elaborates the context and rationale of the study and serves to highlight the compelling factors and primary drivers of the investigation. From such elaboration, the chapter makes explicit the problem statement, the purpose of the study, its objectives and the proposed significance of the study.

1.1 THE CONTEXT AND RATIONALE

Zambia is a landlocked country covering an area of 752 612 square kilometres and occupying approximately 2.5 percent of the total surface area of the African continent (Central Statistical Office, 2009; Zambia National Tourist Board, 2006). As such, the country shares borders with eight countries: the Democratic Republic of the Congo in the north; Tanzania in the north-east; Malawi in the east; Zimbabwe and Botswana in the south; Namibia in the south-west; and Angola in the west. The Zambian population was estimated, in 2009, to stand at eleven million people (Central Statistical Office, 2009). However, the Zambian census conducted just one year later, in 2010, recorded the population to be thirteen million people, with a population growth rate of 2.8 percent (Central Statistical Office, 2011). In addition, the 2006 Annual Report of the Zambian Ministry of Health (Ministry of Health, 2006) revealed that the delivery of healthcare within Zambia's borders was not restricted to Zambian citizens alone and implied that beneficiaries of the national healthcare budget included citizens of neighbouring countries and not only the official Zambian population.

The vision of the Zambian Ministry of Health has been stated as seeking 'to provide Zambians with equity of access to cost-effective quality healthcare as close to the family as possible' (Ministry of Health, 2008). This vision has been embraced within both the National Health Strategic Plan and National Development Plan (Ministry of Health, 2005; Ministry of Finance and National Planning, 2011). Within this notion of a quality healthcare provision are the availability of, and access to, safe and cost-effective radiological services, at all levels of healthcare. In order for such a vision to be achieved,

the underpinning radiological expertise (human capital) and relevant technologies (infrastructural provision) would need to be tabulated, evaluated and, if found to be inadequate to need, bolstered and enhanced in collaboration with appropriate institutions. There is therefore an urgent need to establish the current position of the radiological services in relation to the Ministry of Health's vision, in order to determine the nature and scope of appropriate remedial action. Within this context, the researcher would see the need to adopt, or adapt, a developmental methodology towards the achievement of the stated vision.

There are currently three radiologists known to be working within the Zambian public health sector (Koot and Martineau, 2005; Ministry of Health, 2011). This meagre number represents a huge challenge within the context of communities' increasing demand for improved healthcare service provision. The situation is further compounded by the Zambian Ministry of Health's determination in upholding the policy of equitable distribution of health services (Kombe *et al*., 2005; Ministry of Finance and National Planning, 2006), the challenges of diagnostic interpretation and reporting in the midst of changing disease patterns associated with HIV/AIDS prevalence and the concurrent pursuit of the Millennium Development Goals (MDGs) of the United Nations in which MDGs 1, 4, 5 and 6 either relate directly to, or can be indirectly linked to health (United Nations, 2000).

Diagnostic radiology uses various forms of radiation (ionizing or non-ionizing) to interact with selected bodily tissues in varied ways and yield anatomical and/or functional information (Shaw *et al*., 2009). Radiography or medical imaging, backed by appropriate technology and competencies, plays a pivotal role in realising any radiological image. A comprehensive diagnostic radiology department comprises a wide range of imaging modalities, including; conventional radiography, computerised tomography (CT), magnetic resonance imaging (MRI), ultrasonography including echocardiography, mammography, radionuclide imaging (RNI), and Bone Densitometry (Snaith, 2011). Molecular neuroimaging in the diagnosis and management of neurological disorders is among the modern spheres of diagnostic radiology (Shen *et al*., 2011). Existing competency-based radiological specialities can be linked to body parts or systems, such as cardiac or cardiovascular, and associated with appropriately dedicated imaging modalities.

Specialisation can also be framed to application of varied imaging modalities across a wide range of bodily parts or clinical conditions or questions. Interventional radiology is seen as an extended dimension of diagnostic radiology by aiding the techniques of obtaining bodily tissue, as in MRI-guided biopsy for pathological analysis. It also extends to being therapeutic in place of open surgery as in interventional procedures including; endovascular repair of aortic aneurysms using stent insertions, embolization of cerebral aneurysms, and colonic stent insertion in colonic cancer (Shaw et al., 2009; Grignon et al., 2012). Image guidance also plays an important role in radiosurgery (form of non-invasive radiotherapy) and intensity modulated radiotherapy (IMRT) because it supports accurate target localization and precise avoidance of adjacent organs-at-risks (OAR). A number of imaging modalities including: ultrasonography with varied applications, video-fluoroscopic imaging, 2-dimensional radiographic imaging, CT and MRI are used in image-guided radiotherapy (IGRT) with accurately reproducible patient positions and treatments (Lesiuk *et al*., 2012; Jin,Yin and Tenn, 2008) as an advantage for further patient management.

All the sited areas of radiological services call for enormous levels of multi-speciality radiographic expertise and responsibilities to aid safe and effective handling of usually complex radiological machinery in radio-diagnostic investigations and radiotherapy with associated procedure-guidance, depending on disease process. Lack of corresponding expertise can be a source of far reaching need for referrals from hospitals extending to overseas, and inadequacy to justify acquisition of the state of the art radiological machinery on account of questionably limited available expertise. This observation does, however, not preclude existence of various levels of expertise that warrant referrals as normal healthcare practice worldwide for patients to be referred from one level to another when a justifiable need arises. Chakwe (2011:1) cites the president of Resident Doctors Association of Zambia (RDAZ) regarding prevalent views on human capital in the healthcare sector, with specific reference to the radiology departments, who states that "at the moment the shortages are too much that it is difficult to appreciate all the hard work that the health workers are putting in, so we [as RDAZ] hope that the facilities and the training institutions for health personnel can be expanded and upgraded so that the output would take care of both the quality as well as the quantity...certain things needed to be in place like laboratories and radiology in order to reduce on the referrals".

Within the Zambian context, most radiology departments are under the management and care of radiographers, with limited expertise in those areas ordinarily understood to fall within the domain of radiologists, such as radiological diagnosis and contrast-aided specialised investigations. Whilst radiographers themselves may currently be advocating, somewhat cautiously, to have their roles extended to include such skills as diagnostic reporting, their attempt in this regard is far from new. This current, albeit hesitant, attempt to upgrade and extend skills is not unlike an aborted attempt, in 1924, when there was, within the United Kingdom (UK), a similarly insufficient level of education and training in radiography (Burrows, 1986).

Diagnostic radiological or radiographic reporting expertise, at the desired level of competency, is amongst the most highly sought elements of role extension amongst radiographers (Price, 1989; Bently, 2003). The subject has been debated amongst radiographers since 1965, and has cautiously been referred to as "commenting on radiographs" (Rudd, 2003) rather than by the term, "radiological reporting", which has been reserved for use by radiologists who have the legal entitlement to the term. Despite the reality that radiographers in most Zambian hospitals work without radiologists, the role of radiological input in clinical decision-making, through the implementation of radiological investigations and subsequent reporting of radiological findings, is of critical importance. The availability of degree-level educational programmes in radiography at various universities, across the globe, represents an underexplored opportunity for the evolution of changes in radiographic education and training that acknowledge the oftentimes sparse availability of radiologists, the critical role of radiological interpretation within clinical decision-making and the need for higher levels of competency in radiological interpretation amongst radiographers.

The concept of human capital refers to the capacity and benefit arising from investment and development of a person's knowledge and skills, synonymous with the investment in equipment that is the hallmark of good business practice. Such investment is related to the determination of cost or input and returns or benefit arising from such input (Becker, 1994). Along with investment in human capital, other important areas of investment that have notable influence on healthcare service delivery include investment in medical

equipment and infrastructure. In the evaluation of the nature and scope of investment in healthcare delivery, it is also worthwhile to have a clear understanding of population distribution, geographical location, socioeconomic activities, educational levels and associated government policies (Central Statistical Office, 2000 and 2011).

The Zambian Central Statistical Office (2000, 2008 and 2009) cites mining, agriculture and tourism as Zambia's highest ranking economic activities. The wellbeing of a nation's workforce becomes a critically important consideration, in view of the link between appropriate response to health-related challenges and socioeconomic success or failure. This link further emphasises the cardinal importance of human capital investment in the pursuit of economic progress. The interdependence of various socioeconomic factors as contributors to national success makes it imperative to reflect on the adequacy or inadequacy of the current radiological services in Zambia, in the absence of adequate numbers of radiologists. A healthcare delivery system with optimal radiological services, accessible to all citizens, including peasant farmers in the rural communities, may be seen to be an essential contributor towards poverty reduction. Poverty reduction, in this sense, may be understood in terms of the reduction of monetary expenditure and time involved in accessing scarce radiological services by a self-employed rural peasant farmer, to the detriment of domestic economical productivity.

At a global level, Bently (2003) identifies a notable advance in radiography education and training, at various institutions, from the 1990s. It is well known that radiographers undergo lengthy formal programmes of education and training to acquire knowledge and skills for advanced radiography practice (Bently, 2003). Such education and training increasingly includes clinical radiological skills in pattern recognition and specialised radiological procedures, such as contrast-aided studies of the renal system or gastrointestinal tract. In those instances in which advanced-role activities (falling within the extended training of radiographers) have been assigned to radiographers by supervising radiologists, these are known to be confined to a defined and restricted range of activities (Coleman and Piper, 2008). Such a conservative approach, which Griffin (2002) compares with the "scientific management" approach, which carries considerable ramifications to radiographers' extended roles, but is reliant on a supervising radiologist, may not be

universally effective. In the Zambian context, radiographers are the only key personnel in most radiology departments.

It is thought that a competency-based approach, involving a wider scope of extended practice amongst radiographers, would be more reassuring to patients and would better address the current situation, within a contemporary holistic patient care model (World Health Organization, 2007). There is a need to engage the expertise of the few radiologists in Zambia, whilst working closely with radiographers towards optimizing the radiological service delivery to the Zambian population. Such a coordinated effort is expected to facilitate the upgrading of the radiological services within the country to include interventional radiology, despite the small number of radiologists.

Within the context of an increasing demand for radiological services, as acknowledged by the Ministry of Health Strategic Plan (Ministry of Health, 2005), this researcher sees a worsening radiological healthcare delivery situation if no urgent corrective measures are undertaken. The specific remedial interventions to mitigate the current situation are yet to be identified. These interventions are certain to extend beyond the mere inclusion of radiological images as feedback to clinicians' radiological requests.

Whereas the extension of radiographers' skills has been appreciated in more developed countries and in some of Zambia's urban areas, the very low number of radiologists, irregular application of role extension amongst radiographers, and a largely rural population distribution makes the goal of equitable access to health care to all citizens extremely difficult. The majority of Zambian citizens, [61 percent (Central Statistical Office, 2011)] live in rural regions, leading a predominantly traditional way of life, far removed from urban role-extension developments.

Worldwide, the need for a revised scope of practice through, *inter alia*, the "enhancement of existing work roles; substitution of one type of worker for another… transfer or relocation of particular roles or services from one health care sector to another" (Krupp and Madhivanan, 2009:1), has been seen as one of the most effective strategies employed to address the shortage of human resources within the field of health. Price (2006) acknowledges that role development within radiography is currently an accepted process,

driven by the advent of technological innovations, such as computerised radiography, nuclear medicine/radionuclide imaging, computerised tomography and ultrasound. In response to technological innovation, radiographers embrace new radiological technologies and are seen to couple such incorporation with parallel adaptation of their practices, in pace with emerging service demands. Similarly, Price, High and Miller (1997) have emphasised the promotion of role extension, precipitated by an increasing number of functions within radiology departments. In this case, radiologists have been compelled to extend their roles in multimodality radiology departments, which increasingly incorporate interventional radiology. The traditional roles of the radiologist, such as radiological reporting, have been increasingly shifted to radiographers. The knock-on effect of this development has seen other healthcare personnel being recruited to take up non-radiographic or lower level radiographic roles, such as clerical work and image processing.

1.2. THE PROBLEM STATEMENT

Equity in the distribution of cost-effective and quality healthcare service as close to the community as possible is at the core of the Zambian National Health Strategic Plan (Ministry of Health, 2005). Human capital, in the form of technical knowledge and skills invested in people towards achievement of the productive set goals of an organisation in conformity with societal needs, can be understood to be a key factor in Zambia's progress and success. Human capital represents the capacity of human beings, as productive agents, to promote income generation through the accumulation of knowledge, the acquisition of skills and the advancement of competencies (General Accounting Office, 2002). Within the context of health, the economic benefit of human capital investment goes beyond the employability of skilled practitioners. It is a cardinal factor towards communities being efficiently served without being unduly distracted from the activities of socioeconomic livelihood. The Zambian Ministry of Health's vision, as contained within the National Health Strategic Plan (Ministry of Health, 2005), emphasises equity of access to cost-effective and quality healthcare services by all citizens. This vision seeks to deliver the cited services, regardless of area of habitat within Zambia. Griffin (2002) has observed such a vision to require strategic commitment by management structures, employee involvement, appropriate technology and a reliable design for optimal service delivery. The identified shortage of radiologists in Zambia makes the attainment of equitable access

to optimal radiological services difficult, or impossible, within the current radiological health service delivery provision.

1.3 THE PURPOSE OF THE STUDY

The purpose of the study was to develop a framework for sustainable radiographic human capital development that embraces reliable advanced radiography practice in Zambia, with special focus on those radiological settings that do not enjoy the services of a radiologist. It was expected that such a framework would guide policy development aimed at attainment of optimal access to radiological services by all citizens, including those living in the most remote rural regions of the country and those engaged in extremely low-income livelihoods.

1.4 THE OBJECTIVES OF THE STUDY

The objectives of the study were to:

a. analyse the existing radiographic services and/or practices in rural Zambian healthcare facilities without a radiologist in the context of the country's National Health Strategic Plan (Ministry of Health, 2005);
b. examine the views of radiographers, physicians and patients/clients in hospitals without radiologists, regarding the adequacy of current radiological service delivery;
c. determine the desirable competencies for frontline radiographers in comprehensive radiological services delivery, as well as the benefits of such competencies to the community and the health service facilities;
d. analyse the managements' expectations regarding frontline radiographers' capabilities in rendering comprehensive radiological services in healthcare settings without the radiologists;
e. formulate, implement and evaluate a training programme for radiographers for comprehensive radiological services; with specific reference to client satisfaction and radiographic competencies; and
f. develop a framework for human capital development for frontline radiographers towards the rendering of comprehensive radiological services.

1.5 THE SIGNIFICANCE OF THE STUDY

The researcher has, since 1989, had an opportunity to serve as a radiographer in various rural and urban radiology departments, in both the developing and the developed world. He has previously investigated the precarious situation of radiological service delivery, without radiologists, within the Zambian context (Munsanje, 1996) and has been actively involved in the education and training of radiographers since 2000. The challenge in improving Zambian radiological services extends beyond the mere availability of advanced radiological machinery, to encompass, also, the availability of required education and development of the skills required for optimal radiological service delivery. Outside of the current efforts, there has been no projected equitable radiological service delivery plan that encompasses the distribution of those clinical skills traditionally associated with radiologists to the entire country.

It has been observed (Shanks, 1965; Rudd, 2003; Sim and Radloff, 2008) that since 1965 increased responsibilities have been assigned to radiographers on an *ad hoc* basis. Such assignment of responsibility has been decided by radiologists, being the traditional holders of power (Rudd, 2003; Ransome, 1992) within their respective radiology departments. These *ad hoc* arrangements have not arisen out of any concerted effort on the part of radiographers themselves and do not reflect consistent work protocols. Such responsibilities are also not specifically licensed by the radiographers' professional bodies.

The heterogeneous scope and varied levels of practice among radiographers in Zambia, despite the standardised profile within practising licenses, poses a remarkable challenge to the regulation of the radiography profession and the services it delivers to the community. This reality calls for research-based data that can inform or initiate Government policy that allows communities to benefit from the expanding knowledge and skills in radiographic practice. The outcome of this research could provide insight into the possible reorganisation of the radiological services, as a capital venture, in Zambia and other countries in similar situations. Importantly, the results should provide much needed information regarding the future of radiography practice in a country with a very limited number of radiology specialists. Through detailed analysis, radiographers' career paths,

through the inclusion of extended roles, built upon a foundation of appropriate education and training, can be established and accredited.

This researcher sought to determine a cost-effective radiological service delivery design that would yield economic advantage to the citizens through improved accessibility to services. At present the required radiological services are unavailable in local hospitals, which prompts clients to seek these services elsewhere, at considerable cost – in terms of transport and lodging costs – and with variable success. Such costs are seen to be in conflict with poverty reduction efforts at household level and Government-driven poverty alleviation initiatives (Milimo, Shilito and Brock, 2002).

The intervention was considered to include investment in radiographers' education and training, as a means of upgrading radiographic capabilities and to consequently contribute to the improvement of radiological service delivery and accessibility. Through such investment, vicarious economical benefit to the community was predicted, through extended radiological competencies among radiographers. Such radiographers, with an extended range of competencies, would be cardinal as frontline practitioners in those radiology departments presently without radiologists. In addition to the cited role in poverty reduction, the initiative would also facilitate the early detection of disease, in view of the significant role that radiology plays in diagnosis.

The research effort was viewed, furthermore, to aid the Zambian government in its appreciation of the huge challenges existing within the sector of radiological service delivery, as well as a corroborated route towards their solution. Governments have an obligation to provide optimal healthcare services to the community, in order to sustain a healthy national workforce. The combination of a healthy national workforce with the requisite knowledge and skills are recognised as being the human capital investment necessary for the pursuit and extension of national economic development (Bishop, 1990; Becker, 1994; Marimuthu, Arokiasamy and Ismail, 2009). This study sought to find a solution to the question; "what radiographic human capital would make the most significant contribution to the provision of optimal radiological services in areas without radiologists, with specific reference to rural Zambia?" As would be the case in a retroduction research strategy, this study was centred on: what solutions would be vital?

Within this strategy there is, therefore, no need for a hypothesis since the retroductive or abductive (Robson, 2002; 2011) research strategy is based on a cyclical process of interrogation, as opposed to a unidirectional and linear logic. The strategy is built upon data-based explanations and relationships which form a basis for postulation or proposed remedial structures and designs, which are then piloted as action whose outcomes are evaluated in the light of the starting phase that pointed to the problem.

CHAPTER 2
LITERATURE REVIEW

This Chapter reviews the literature on healthcare delivery system in Zambia, under which the radiological and radiography services are provided. The literature pertaining to global radiography practice, extended roles in radiography practice and human capital developments are reviewed accordingly. The concept of human capital is appraised in terms of its relevance in discerning the value of human capital investment.

2.1 HEALTHCARE DELIVERY SYSTEM IN ZAMBIA

The National Health Strategic Plan (Ministry of Health, 2005), for the period 2006 to 2010, was prepared at a time when the health sector was undergoing a number of health-related challenges, *viz.* the increased disease burden associated with HIV/AIDS, shortages of healthcare practitioners and inadequate infrastructure. This period was also associated with a restructuring of the health sector and the legal framework as it related to the organisation of the Ministry of Health. Such challenges, compounded by economic limitations of government funding of the health sector, had a significant impact on the organisation and management of the health sector (Nakajima, 2006). A successful healthcare delivery system is, further, characterised by appropriate supportive national policies and strategies, well-informed professional leadership and sustainable investment priorities.

The changes in the Ministry of Health through the amendment, or repeal, of the National Health Services Act 22 of 1995, as the National Health Services Act 17 of 2005 (Republic of Zambia, 2005: 107-114), permitted the dissolution of the Central Board of Health which served as the policy implementation wing of the Ministry of Health. These changes also forced the restructuring of the Public Service Reform Programme, in which the functions of both policy formulation and implementation fell within the mandate of the Ministry of Health.

The Zambian National Health Strategic Plan (Ministry of Health, 2005) articulates its vision to purposefully improve the equity and effectiveness of healthcare service delivery. The Sixth National Development Plan 2011-2015 (Ministry of Finance and National Planning, 2011), similarly, pursued the vision "to provide Zambians with equity of access to cost effective, quality healthcare as close to the family as possible". Whilst the vision of equity of distribution of healthcare services is, both desirable and admirable, effective policy guidelines and a milieu of Total Quality Management (TQM) may be considered to be critical components of effective implementation. Such a vision would, similarly, come to fruition on the back of strategic and broad-based commitment, employee involvement, the availability and utilization of appropriate technology, the correct materials and the implementation of a sustainable methodology (Griffin, 2002). From the perspective of World Health Organization (WHO), people-centred healthcare initiatives encouraging dialogue and initiating action are seen as helpful to governments and other health partners as "...endorsed by WHO Member States during the fifty-eighth session of the Regional Committee for the Western Pacific held in the Republic of Korea in September 2007...[for] identifying and adapting policy reforms and interventions to their unique settings at national and local levels [towards] ...desired goal and vision" (Omi, 2007: 1).

In the face of competing remedial imperatives, prioritization was given to those interventions that would have the most significant positive impact, or those outputs arising from optimum use of the available institutions and expertise in radiology or radiography. Such a strategy of prioritization within the implementation of multiple corrective remedies was conceived as part of the solution towards improved healthcare delivery, as articulated in the National Health Strategic Plan (Ministry of Health, 2005) and maintained within the Sixth National Development Plan (Ministry of Finance and National Planning, 2011). By the year 2008, at least 71 hospitals across the country had been re-equipped with modern radiological machines, through the collaborative effort between the Netherlands and Zambian Governments and the five-year ORET project (Ministry of Health, 2008). At the time, it was expected that the Government's updating of radiological equipment would be an ongoing process, moving in step with advances in radiological technology. Mission healthcare facilities are also overseen by the Government and considered within the National Health Strategic Plan. As such, the Mission hospitals were also among the intended beneficiaries of the ORET project improvements.

Notwithstanding the fact that healthcare delivery is primarily the responsibility of governments (Asante and Zwi, 2007), public-private partnerships are seen to contribute to addressing the financial and human capital inadequacies associated with the goal of healthcare equity. Those efforts aimed at re-equipping radiology departments, such as the researcher described above, may be viewed as fundamentally incomplete if such re-equipment initiatives are not coupled with a corresponding availability of competent radiological skills to ensure effective radiological service delivery. The challenges posed in the desired radiological service delivery are able to be overcome through investment in the workforce and improved extended competencies within radiology departments. Such investment and role extension ought, furthermore, to be based on the formally assessed needs of those clients who most require access to these radiological services (Cohen, 2005).

Prior to the 1970s, the basis of the current advancement in radiological technology, computer application, is known to have taken about 356 years of multi-staged inventions from John Napier's simplification of numerical calculations by logarithms in 1614 to the introduction of the first large-scale general purpose computer by International Business Machines (IBM) in 1969 (Williams, 1982; Kember, 1982). To date, radiological technology has rapidly advanced from the 1970s when computer application in radiology became vividly applicable, leading to current computer-backed highly defining imaging technology ideal for early detection of disease, where compatible competencies are available. According to Goldsmith (2011: 60) "advanced imaging now provides striking images [with improved resolution] of clinical problems, in many cases superior to what can be seen by a naked eye". With incorporation of Digital Imaging and Communication in Medicine (DICOM) in the global context, radiology is seen as the first medical discipline to establish 24 hour diagnostic reporting services aimed at benefiting clients. Among the challenges of such technological advancements is the approach to "influencing the changing structure of professional imaging practice" (Goldsmith, 2011: 160) in view of foreseen alterations in boundaries of clinical disciplines. McKesson Corporation (2012) identifies the Republic of Ireland among the countries thought to be applying the ideal 21st technology, known for coordinated multidisciplinary medical imaging and communication. The Picture Archiving Communication System (PACS) has evolved to National Integrated Medical Imaging System (NIMIS). In this way, radiological consultation is timely as the

practitioners are simultaneously able to view and discuss the radiological results from different locations and the referred patients have their radiological images accessible at any referral hospital serviced by NIMIS - in this case nationwide. Hence, referral processes incorporating effective feedback are also enhanced.

With a meagre number of radiologists to cater for the whole country, in the Zambian context, there would be ineffective or nonexistent communication between physicians and radiologists. Even where NIMIS were to be instantly installed, the low number of radiologists - as low as three for the whole country - would not cope with the workload as consultants. Nevertheless, the clients require optimum radiological services. The types of minimum radiological services recommended at each respective clinic and hospital level, are described within the National Health Strategic Plan (Ministry of Health, 2005) presented as Table 1, below:

Table 1: Planned Public Radiological Facilities

HOSPITAL LEVEL	CATCHMENT POPULATION	RECORDED NO. OF HOSPITALS	MINIMUM RECOMMENDED RADIOLOGICAL SERVICE
Level 3: Third referral	≥ 800 000	04	Computerised tomography (CT), Contrast-aided examinations, Digital radiography, Fluoroscopy, Interventional radiology, Magnetic resonance imaging (MRI), Nuclear medicine, Radiological reporting, Ultrasonography.
Level 2: Second referral	200 000 – 800 000	18	Contrast-aided examinations, Digital radiography, Fluoroscopy, Radiological reporting, Ultrasonography.
Level 1: First referral	80 000 – 200 000	74	Contrast-aided examinations, Digital radiography, Fluoroscopy, Radiological reporting, Ultrasonography.
Community Urban clinics	30 000 – 80 000	1 800	Conventional radiography, Radiological reporting, Ultrasonography.
Rural clinics	≤ 30 000		

2.2. RADIOGRAPHIC PRACTICE

Radiographic practice is known to develop on the back of advancements in technology (Burrows, 1986), as evidenced in the unprecedented radiological innovation spawned from the advent of computer technology in the 1970s. There is every reason to anticipate further advancement of radiological practice, in pace with technological advances into the 21st century. In order for radiological service to be provided in accordance with such emerging technologies, it would be imperative that consideration be given to matching technological expertise. This consideration would entail robust and ongoing Continuing Professional Development (CPD) programmes, backed by the appropriate legal frameworks, such as the Health Professions Act 24 of 2009 (Republic of Zambia, 2009: 349-393), in order to accommodate such upgrading or reorientation of roles within radiographic practice. Similarly, consideration would need to be made of the possible ethical dilemmas arising from the options to extend radiographers' roles in order to provide the desired and necessary services, or territorially to withhold the extension of roles in favour of radiologists, and thereby restrict access to these technologies and services by the majority of the population. This is the quagmire in which Zambia currently finds itself, with a meagre number of radiologists, confined to the urban areas, and a huge demand for services. The National Health Strategic Plan (Ministry of Health, 2005; 2011) cites further that among the recorded 29 institutions offering education and training of various healthcare personnel, only one institution offered a radiography programme.

Conventional diagnostic radiography was introduced in Zambia in the 1930s (D'Arcey-Irvine, 1970), ahead of other forms of radiography such as ultrasound and computerised tomography which emerged in the 1970s (Burrows, 1986). In these early years of Zambian radiography, a two-year certificate programme produced x-ray assistants whose roles were limited to basic radiographic techniques and focused on the 'what' and 'how' of plain film radiography. As radiographic responsibilities increased, this two-year x-ray assistants' programme was replaced by a three-year diploma programme, which was introduced in 1970 (D'Arcey-Irvine, 1970). This diploma programme incorporated an additional enquiring clinical dimension that was built around the 'why' of radiographic practice. This level of education and training supported radiographers' competencies in handling

advanced radiological equipment and technical procedures, whilst promoting the requisite levels of care to both patients and radiological equipment (Price, 2006).

Radiographers who were provided with such a level of training were equipped with sufficient radiological and communication skills to allow them to work effectively with radiologists. The radiography programme, such as has been described, has been offered by the Evelyn Hone College, working in conjunction with the University Teaching Hospital and several other hospitals countrywide for implementation of clinical training, since 1970. The first graduation of diplomates in radiography was recorded in 1973 (Evelyn Hone College, 2008). By 2011, approximately 450 diploma-trained radiographers had graduated from the Evelyn Hone College and 226 radiographers had been employed by the Ministry of Health (Ministry of Health, 2011).

Most radiology departments in Zambia have been functioning below acceptable standards of radiological practice on account of the unavailability of radiologists within these departments. This arises directly from the critical deficiency in the total number of radiologists in the public sector. The current reality of radiology departments without radiologists has resulted in notable ambiguity with respect to the radiographer's effective role within such departments, which vacillates between that of their professional tradition and roles imposed by patients' and clinicians' clinical expectations. The legal criteria relating to forced extended practice amongst radiographers have also not been explored (Munsanje, 1996).

Ideally, radiologists and radiographers work in professional partnership towards a common goal of effective radiological service provision. Nevertheless, a solution to the challenge of achieving a realistic number of radiologists for purposes of running effective radiological services within the Zambian context has not yet been achieved. In the meanwhile, the Zambian population is currently estimated to total thirteen million people, with a growth rate of 2.8 percent (Central Statistical Office, 2011). Table 2, overleaf, from the review report, "Zambian Health Workers Retention Scheme 2003–2004", which was prepared at a time when the Zambian population was reckoned to total a little over eleven million people, tabulates the ratio of physicians, radiologists and radiographers to the total population (Koot and Martineau, 2005):

Table 2: The Ratio of Public Sector Physicians, Radiologists, Radiographers, to Population

STAFF	NUMBER	POPULATION (CLIENTS) PER STAFF MEMBER
Physicians	646	17 589
Radiologists	3	3 787 601
Radiographers	139	81 747

A survey undertaken in the United Kingdom in 1968, which was prior to the advent of the busy multimodality radiology departments that are characteristic of more modern times, indicated that a low percentage of medical students (30 percent) were inclined to consider radiology as an area of specialisation, due to perceived clinical overload at all levels of practice including that of consultant (Lodwick, 1968). Such a pattern of overload was perceived to be restrictive, and/or inconvenient, to the pursuit of formal CPD and research. Ironically, the competencies and skills that are promoted through CPD are an important source of job satisfaction and stress reduction, arising from positive feedback from patients/clients and healthcare colleagues (Graham *et al.*, 1999).

The notion that competencies and skills are sought when a learner recognises the importance of those competencies and skills in a desirable functional area has been described as early as the time of Socrates [(469–399BC); Plato, 1937]. This notion persists into modern times and is described in Benziger's (2008) description of conscious incompetency or competency. This notion has also been evidenced in the observation that healthcare workers would leave their respective institutions (that did not offer CPD) for other institutions that incorporated CPD (Nabwera, Purnell and Bates, 2008). Opportunities for CPD have also been identified as a significant causal factor in the movement of healthcare practitioners from developing to developed countries (Chimanikire, 2005). These observations are also consistent with Social Cognitive Theory (Bandura, 1986) which holds that self-efficacy beliefs and/or awareness provide the foundation for human motivation, well-being and personal accomplishment. This theory argues further that unless people believe that their actions lead to desirable outcomes, they are unlikely to persevere in those activities (Pajares, 1997).

2.3. EXTENDED ROLES IN RADIOGRAPHIC PRACTICE

By the mid-1980s, findings arising out of a protracted debate among a range of healthcare professionals, including radiologists and radiographers, had justified the implementation of role extension in radiographic practice - as long as there was training that supported such role extension (Snaith and Hardy, 2008). The Radiographer Abnormality Detection Scheme (RADS), incorporating the 'Red Dot' scheme, was among the most notable aspects of radiographic role extension. The need for such an 'abnormality detection' component of radiographic role extension was realised as early as 1924, when one of the early British radiography personnel, Blackall, had suggested the inclusion of abnormality detection by the on-the-job trained radiography assistants (Burrows, 1986). At that time, the suggestion was made as a means of reducing the workload among surgeons, who were the principal interpreters of plain film x-ray. Blackall's suggestion was not supported by the physicians, who argued that these extended responsibilities would be too demanding in the absence of formal education and training programmes.

More recently, within 2000 to 2013 *[see Table 3]*, the College of Radiographers advocated the evolution of pattern recognition skills among radiographers from the Red Dot Scheme to one of diagnostic comment (Paterson *et al.*, 2004; Coleman and Piper, 2008) and clinical reporting (The Society of Radiographers, 2013). The development of the Radiographer Comment Scheme took cognisance of the positive outcome from radiographers' participation in the Red Dot Scheme, which was based on radiological pattern recognition and sought to upgrade and extend these to include descriptions and comments on diagnostic radiological features (Hardy and Culpan, 2007). With a view to improving the reliability of such a role extension, in-house short courses in the radiological patterns of musculoskeletal trauma were offered to some radiographers, at the discretion of radiologists. Despite these courses, it was soon concluded that the accuracy of Radiographer Comments was significantly less than the accuracy of Red Dots for the same radiographic images. This reduced accuracy brought into relief the need for an appropriate training specifically designed to improve the accuracy of radiographers' comments. One driver of the evolution towards the Radiographer Comment Scheme was that the Red Dot Scheme, in itself, occasionally compelled physicians to seek comments. Such comments were preferably sought from radiologists, but it was found that their own increasing

workloads often rendered radiologists unable to meet the overwhelming demand (Swinburne, 1971; Loughran, 1994).

The process of radiological diagnostic reporting is ideally set out to answer or address the presented clinical question/s and involves pattern recognition, including measurements, based on biophysical image characterisation from interaction of radiation with bodily matter. Wang (2001: 26) generically defines pattern recognition as identification and classification of patterns amidst a background and identifies humans as "...the best pattern recognizers..." The Red Dot Scheme which served to be a means of communicating to the clinicians is differentiated from the stance of pattern recognition, which is a cognitive process underlying description of radiological patterns. These patterns are subsequently interpreted for diagnostic radiological detection of disease and communication to the clinicians. This order of events maintains Bowman's (1991) perspective regarding Red Dot Scheme as a mere formalisation of communicating the radiographers' earlier ignored pattern recognition abilities worth developing with consequent written communication, as tangible output, to clinicians. The comment or opinion as part of the report to addressing the clinical question in such communication would be accompanied by image-based descriptive evidence, unlike mere concluding comments associated with some film viewing sessions (Shaw *et al*., 2009). The radiological pattern descriptions, which reflect biophysical status, require interpretation to conclude the diagnostic radiological report. These are factually described radiological patterns interpreted with regard to clinical question/s and relevant context or information to aid expert opinion regarding conclusion, advice or recommendation (European Society of Radiology, 2011; Lamb, 2007).

The observation by Goldsmith (2011) that today's medical imaging technology is capable of providing detailed images, signifies the availability of superior image detection, processing and display technology of image signal, as information conduit (Wang, 2001). As such, competencies surrounding pattern recognition entail interpretation of image patterns into information for answering or addressing clinical questions. The radiological report document is, therefore, achieved through an intellectually involving multi-staged process inclusive of quality related technical considerations and objective pattern recognition towards diagnostic clinical opinion. Radiological reporting may be understood to be a cardinal component of diagnostic radiographers' extended roles, as all radiological

requests would ultimately require some narrative feedback to the underlying clinical question. Without effective diagnostic communication of this nature to guide clinical decision-making, many diagnostic radiological investigations would be of little clinical value and effectively a wasted cost. Table 3, overleaf, tabulates (in reverse chronological order) the evolutionary path towards a paradigm of formal diagnostic reporting amongst radiographers.

Table 3: The Evolution of Radiological Reporting amongst Radiographers

REFERENCE ERA	DEVELOPMENTAL EVENT
2000s	Delineation between Preliminary Clinical Evaluation and Clinical Reporting stipulated for Policy and Practice Guidance *(The Society of Radiographers, 2013).* Policy and Practice guidelines on radiological reporting by radiographers recommended *(Paterson et al., 2004).* High accuracy levels in radiographic pattern recognition among radiographers noted as a justification for the upgrading of the ambiguous Red Dot Scheme to include diagnostic comments, towards radiological reporting *(Coleman and Piper, 2008).*
1990s	Research recommends comprehensive training and detailed work protocols to successfully manage extended roles. Research finds 88% to be the radiographers' accuracy rate in the detection of radiological trauma patterns in an emergency department *(Loughran, 1994).*
1980s	The need for radiographers' role extension is linked to an excessively unmanageable workload for a small number of radiologists. Multimodality radiological practice increases demand in diagnostic, interventional and therapeutic radiology for a small number of radiologists. The Red Dot Scheme is introduced. Arguments regarding the perception that the Red Dot Scheme merely formalises existing practice. Radiography education and training is upgraded to degree level *(Bowman, 1991).*
1970s	Computer application to radiology leads to advancements in radiological technology and the invention of additional radiological machinery and applications. More demanding radiological procedures for radiologists, leave no, or a reduced amount of time for traditional reporting *(Swinburne, 1971).*
1920s	Radiography education and training commences. X-ray assistants' suggestion to indicate radiographic trauma patterns is aborted amidst physicians' protest, citing informal learning amongst x-ray assistants. X-ray assistants are recruited by surgeons *(Burrows, 1986).*

In his examination of radiographic reporting practice between 1965 and 1999, Rudd (2003) explored the breadth and depth, the ethics and the legality of the practice. He observed the consistent demand for radiographers to deliver diagnostic reports, as a consequence of

increasing workloads amongst radiologists, radiographers' discontent with their traditional role, and pressure on hospital managers to facilitate the provision of efficient radiological services in keeping with public expectations. The consideration of public expectation is an important determinant of patient or client satisfaction, whilst positive or negative feedback on the quality of service from clients contributes to radiographers' job satisfaction or dissatisfaction, respectively. A high level of competency within departments is recognised as an important driver of a positive professional reputation amongst patients or clients (Graham *et al*., 1999).

With reference to King's Daughters Medical Center, which has been measuring patient satisfaction for more than 108 years, Lindberg and Kimberlain (2009:1) proclaimed; "Poor service quality is not usually caused by apathetic staff and unwilling managers, but rather by a system that fails to support them [the workforce]." Healthcare managers are, therefore, expected to be as aware of not only financial performance but also patient satisfaction performance. The latter may involve training investment to realise desirable employees' competencies towards notable improvements in client satisfaction, which would also contribute to staff satisfaction as observed by Graham *et al*. (1999). The underlying undertaking among healthcare professionals to ably serve the healthcare needs of other members of the society, can serve as an embedded asset. The undertaking requires support such as in the form of necessary competencies, equipment and infrastructure to meet holistic healthcare provision – including client satisfaction and job satisfaction. It is also worthwhile to note that views regarding satisfaction with the radiological services would be drawn from the patients as 'external' clients, as well as from the clinicians as 'internal' clients. There are technical aspects relating to the quality of the radiological services that are better appreciated by the clinical practitioners rather than the patients (Brown *et al.*, 1990: 12).

The Irish Society for Quality and Safety in Healthcare (2003) observed patient satisfaction as a relative measure which may be influenced by several factors, notably; patient expectation, age, nature of illness, prior associated experience, patient-professional relationship, own choice of service provider and socioeconomic status. Crow, Storey and Page (2003) uphold the consistent evidence across settings that the most important healthcare service factor affecting satisfaction among patients was the patient-practitioner

professional relationship. This interpersonal relationship, however, included technical information and competency on the patients' concerns. This patients' standpoint has been seen as significantly contributing to the patients' compliance or noncompliance to healthcare advice (Bruce, 2006). In this regard, radiological image interpretation and reporting by radiographers can be seen as both an example of technical information and of a competency associated with patient satisfaction within the contexts of patient-practitioner relationships, or, in the case of the radiographers interacting with physicians and other healthcare workers, practitioner-practitioner relationships.

The question of which radiological competencies would be feasibly prioritized for frontline roles to engender other pressing roles would require technical mindset from relevant healthcare service technocrats, including radiologists, physicians and radiographers, preferably to make a decision with historical, current, and forecasted perspectives. A decision would be about feasible perspective to underpin or embrace other foreseeable extended roles. As to whether or not every radiological examination requires a radiological report, the consensus view is overwhelmingly in favour of the affirmative (Brown *et al*, 1990; Robson *et al.*, 1999; Wilcox, 2006; Grieve, Plumb and Khan, 2010). Rudd (2003) suggests, however, that the answer to the inevitable question that arises out of this imperative, as to the scope of radiographers' involvement in frontline radiological reporting in those instances in which radiologists are scarce or not available at all, is to be found within individual radiology departments. In view of such a reality, the American Registry of Radiologic Technologists, which effectively serves as a registration body to radiographers, has recognised extended role certification of the Radiologist Assistants' qualification (Quinnipiac University, 2009). This certification pertains to radiographers' extended roles, in the forms of initial observations on diagnostic images and specialised radiological investigations (Williams, 2009). In terms of this registration, the endorsed practice is under the direct or onsite supervision by radiologists who make final written reports. Such practice suggests that the supervising radiologist ought to be present and directly observing the Radiologist Assistants' work, or minimally within the premises and able to be called upon as the need for specialised assistance might arise.

"Radiography practice continues to evolve rapidly and the higher levels of responsibilities and autonomy carried by the profession have been shown to be beneficial to

patients/clients and to provide the radiographers and support staff with increased job satisfaction" (European Federation of Radiographer Societies, 2011: 10). The European Federation of Radiographer Societies (EFRS) is a professional organisation set up in 2007 after many European radiographer societies are known to have been meeting and cooperating already since the nineteen fifties (EFRS, 2013). Through a signed agreement, the EFRS is also known to be in official collaboration with the International Society of Radiographers and Radiological Technologists (ISRRT). The EFRS recognises and supports the radiographers' extended roles from member societies and the need for well informed educational strategies to sustain desirable outcomes for both the existing and forecasted radiographers' extended clinical responsibilities.

Snaith (2011: 6), consultant radiographer, refers to Mid Yorkshire Hospitals under National Health Service (NHS) Trust in the UK where the radiographers with approved education, training and mentored competencies were "reporting in general radiography, ultrasound, computed tomography (CT), fluoroscopy and developing reporting roles in bone densitometry..." by 2009. Based on the prerequisite premise of approved education, training and mentorship the radiographers also performed diagnostic breast interventions, barium enemas, proctograms, hysterosalpingograms, videofluoroscopy and sigmoidoscopy. The achieved levels and scope of practice are now seen as ordinary areas of specialisation in radiographic practice, yet still unattained or/and un-pioneered in many parts of the world. The frontier extended radiographic role discussions would currently involve consultants' roles for promoting leadership in practice, service provision, research, education and training (Snaith, 2011). Such worthwhile achievements call for planned investments, attributed to cost of education, training, mentorship, and higher responsibilities including competency-based professional leadership. Boonstra and Vink (1996) have identified ill-defined leadership structures to be among barriers to technological and organisational innovations.

The practical and authenticated levels of extended radiographic roles in many African countries, without known exception, have been observed as sluggish despite the escalating volume of radiological work coupled with current complexity and diversity of related technology (Gqueta, 2012). This state of affairs leaves the question of radiographers' practical involvement in optimising radiological service delivery to equitably reach far

flung primary healthcare facilities yet to be answered. Witcombe and Radford (1986), respectively a radiologist and a radiographer, jointly investigated the impact of radiographers' involvement in diagnostic ultrasound imaging and reporting in the UK and concluded that radiographers, actually, offered over 70 percent of obstetric ultrasonography services in the UK. According to Gqueta's (2012: 25) study on radiological needs involving a South African primary health care level of healthcare in Cape Town, "...the deployment of newly qualified medical officers with limited experience on image interpretation, the absence of radiologists, the failure of the radiography education to prepare the radiographers for these challenges and, the legal restriction placed on radiographers that seek to respond to these challenges within the clinical environment" all amount to impeding predicaments for a breakthrough in radiographic role extension. It has also been viewed that, apart from the role of diagnostic radiological reporting being the oldest radiologist's role, this role continues to emerge as the most commonly documented topic among the radiographers' extended roles (Williams, 2009). This assertion is also implied in the East African context (Kawooya, 2008) as well as in West Africa where efforts in Mali to apply Information Communication Technology (ICT) to access radiologist's report have been reported (Eugelink and Laureys, 2009).

With regard to a need for postgraduate qualifications in specialised fields of diagnostic radiography, a study involving radiographers employed in Bloemfontein and Kimberly of South Africa, recorded a number of uninspiring factors, in the radiographers' view, to take up higher radiography qualifications. "The limited promotion opportunities in the profession, as it is currently structured, together with the lack of acknowledgement through better remuneration are the main impacting factors on the reluctance of radiographers to enrol for further studies" (du Plessis, Friedrich-Nel and van Tonder, 2012: 114). However, from independent interviews with the radiographers' employers in the same study, three out of four employers dispelled the radiographers' assertions regarding remuneration. Instead, the employers indicated willingness "to offer a radiographer higher remuneration if the radiographer could [successfully] handle more responsibilities as a result of additional qualification...[such as] difficult examinations in general radiography and especially in specialized imaging modalities" (du Plessis, Friedrich and van Tonder (2012: 114). Essentially, the shortage of radiologists was also confirmed in this study. It implied, in this case, that the employers required tangible clinical competencies in what they termed

'more responsibilities' resulting from higher qualifications to justify the investment or matching remunerations. The employers, in both public and private facilities, were also concerned with disruptions in service delivery and flow of business if several radiographers took study leave at the same time. On radiographers' role extension specific to the Zambian context, there has been no known documented literature, apart from Munsanje's (1996) exploratory work. Generally, the Southern African region, including Zambia, or whole African region could still be in varied, rudimentary, phases of attaining such extended roles, unlike the progress made in some developed countries. (Williams, 2009; du Plessis, Friedrich-Nel and van Tonder, 2012).

From historical perspective, radiographic role extension has not been without challenges, as some practitioners could object to such change pointing to radiographers' role extension (Burrows, 1986). As Gill (1995) further cautions, people who are accustomed to a prevailing state of affairs are reluctant to seek out alternatives, particularly when such alternatives are unfamiliar. Besides, McNiff and Whitehead (2009: 8-9) observe that "…different people think about values and logics in different ways…the things people value usually change overtime…" due to several compelling factors. Value based decisions are known to be influenced by prior associated experience/s and, therefore, bound to be unaffected by unknown dimensions (The Irish Society for Quality and Safety in Healthcare, 2003). Remedial explanations on mechanisms for service delivery are known to occasionally be indirectly observable (Blaikie, 2000; 2009) and hence the need to discern evidence of the consequences linked to most likely sustainable approach to the solution would be worthwhile.

2.4. HUMAN CAPITAL DEVELOPMENT

Human Capital Development has been defined as "the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" (Organization for Economic Cooperation and Development, 2001: 18). This definition was earlier inferred by Schultz (1993) who saw human capital as a key underpinning factor, or input (Rastogi, 2000), in the improvement of an organisation's productivity and the sustenance of its competitive advantage. Investment in human capital development is, furthermore, a recognised reinforcement strategy in the poverty alleviation

and the fight against disease, through its capacity to increase personal and institutional productivity and/or efficiency and its tangible returns within the operation of institutions (Son, 2010).

The notion of human capital finds its origins in the observations of a number of 20th century researchers and authors. Lewis might have initiated exploration of the idea of human capital within the context of economic development through the work, *"Economic Development with Unlimited Supplies of Labour"* (Lewis, 1954), in which explicit reference is made to the term, 'Human capital', although the term itself had been used some time earlier within the context of public finance: Pigou (1928) declared the existence of both the concepts of investment in human capital as well as investment in material capital. The application of the term within the context of economic development, however, was expanded by Mincer (1958), in his demonstration of the positive link between employees' levels of expertise, based on training and the resultant returns to the organisation. Spengler (1977) provided further clarification of the concept of human capital, originally advanced in the philosophical work of Smith, as the stock of knowledge and skills embodied in the human ability to perform work for, or towards, economic gain.

This idea on human capital is unlike the philosophy espoused by Karl Marx (1818 – 1883) that relates the worker, as a human being, to labour power and wages (Bowles, Gintis, 1975). Within this philosophical framework, human capital was seen to be akin to fixed capital, and able to be interchanged with other fixed capital such as equipment, buildings and land, based on a finitely determined value. In contrast, it may be contended that the true value of human capital, in terms of knowledge and skills, experience and its embodied attributes, is not able to be assigned a discrete and finite value and is, therefore, not interchangeable with fixed capital.

Becker's work (1994) on human capital, initially published in 1964 and still having currency, has become a standard reference theory for human capital development. Within this theory, human capital finds comparison to physical means of production, such as factories and machines, whilst education, training and medical treatment or healthcare are cited as means of investment in human capital. Becker (1992; 2002), a Nobel Prize recipient in economic sciences theory, further observed that "one of the most influential

theoretical concepts in human capital analysis is the distinction between general and specific training or knowledge". In this respect, he draws attention to the observation that "firm-specific knowledge is useful only in the firms providing it, whereas general knowledge is useful also in other firms" (Becker, 1992: 7).

Human capital investment has also been evaluated in terms of the relative value of returns from education and training to the individual, the firm and the economy (Blundell *et al.*, 1999). The three main components associated with education and training have been identified as: (a) inherent ability, referring to early ability regardless of whether it is acquired or innate; (b) formal education knowledge and skills, referring to knowledge and skills gained through formal studies and training done in schools; and (c) on-the-job knowledge and skills, referring to knowledge and skills acquired through informal learning whilst on the job and within workplaces. O'Driscoll (2009) a learning strategist, notes that in the early stages in skills-learning, there is a greater need for more formal learning, to support informal 'on-the-job' experiential learning. He has noted that these two modes of learning, formal and informal, are intertwined and mutually dependent and respectively analogous to the bricks and mortar required in erecting a solid wall.

It is common cause to note that human capital investments involve an initial outlay in education and training and an inevitable loss of earnings or productivity while employees engage in such studies or training. These initial 'losses' are, however, offset by anticipated gains through increased earnings and higher productivity. As is the case with investments in physical capital (Becker, 1994), the motivation to undertake human capital investment is based upon the reasonable expectation of increased productivity and other value propositions which such capital investment offers to the market or service **(**Osterwalder, 2004). Despite the reasonable proposition of gain associated with human capital investment, the actual measurement of financial gain arising from human capital investment has been described as representing a 'measurement paradox' (Thomas, Cheese and Benton, 2003). The difficulties associated with finite measurement of human capital investment gains are further acknowledged by Kasselman (2006: iv) who has observed that "traditional human resource metrics fail to report on level of performance, knowledge base, or value of human capital" in relation to investment. This observation is a certain

contributor to the concern, hesitance, or avoidance of organisations' executives to routinely authorise funding for education, training and related activities, such as research.

2.4.1. Human Capital Development Theories and Models

There are a number of theories and/or models of human capital development that are in the main based upon business practices and/or models. In this study, the researcher examined a selection of human capital development theories and, out of this examination of predominant theories, proposed a framework to guide the investigation of human capital investment towards the improvement of radiological service provision.

2.4.1.1. *The Strategic Human Capital Management Model*

The Strategic Human Capital Management model was developed by the General Accounting Office of the United States of America (2002). In this model, emphasis is placed upon financial or economic benefit, which includes meaningful value creation from the operations of an organisation and strategic future concerns from investment. The model is premised on four cornerstones or pillars and eight critical success factors. The four pillars of the model are: leadership; strategic human capital planning; acquiring, developing and retaining talent; and results-oriented organisational culture. The eight critical success factors reflect the means by which the success of the organisation may be determined. Table 4, overleaf, describes the four cornerstones and their corresponding critical success factors.

Table 4: The Strategic Human Capital Management Model (General Accounting Office, 2002: 8)

PILLAR	HUMAN CAPITAL CORNERSTONES (Pillar Descriptions)	CRITICAL SUCCESS FACTORS
01	Leadership	• Commitment to Human Capital management. • Prescriptions of human capital functional roles.
02	Strategic Human Capital Planning	• Integration and alignment in human capital. • Data-driven human capital decisions.
03	Acquiring, Developing and Retaining Talent	• Targeted investments in workforce. • Human capital approaches tailored to meet organisational needs.
04	Results-oriented Organisational Cultures	• Empowerment and inclusiveness of workforce. • Unit and individual performance links to organisational goals

The General Accounting Office (2002: 8-9) describes the embedded principles at the heart of the critical success factors to be (a) that people are assets, whose value can be enhanced through investment, as the organisation seeks to maximise value whilst managing risk and (b) that the design and implementation of an organisation's human capital processes should be measured by the extent to which it contributes to the organisation's ability to achieve its mission and goals and lever competitive or economical advantage.

With respect to public health workforce, Roy, Chen and Crawford (2009: S79) examined the perspective of personnel economics approach associated with enhancing "...incentives to attract, retain, and motivate talented ...public health workforce thereby promoting the culture of high-performance government [services]" associated with Strategic Human Capital Management model. This approach appears to be bureaucracy-propelled to, remotely, address challenges at service delivery sites; essentially placing incentives for 'envisaged' improvements. Meanwhile, work performance for promoting social welfare, such as healthcare services coupled with complex dimensions of expertise, still proves problematic to define and measure unlike performance directly linked to profit or cost goals. For example, individual performance, in the former, could be ineffectively or inseparably measured when an outcome for jointly performed work is being considered.

Ford, Bach and Fottler (1997: 74) observed that "measuring the quality of an intangible service product [such as expertise-driven healthcare] has become a great challenge for managers and administrators in the health services industry. While manufacturers can develop quality control methods to ensure that their products meet quality specifications before the customer ever sees them; the service producer does not usually have that luxury". As Brown *et al.* (1990) observed, the efficiency of healthcare service as a notable dimension of quality, affects service affordability where resources are limited, and provides optimum, rather than maximum, care to the patient and the community. The context is therefore one of providing greatest benefit within the limitations of the resources available. Baumgärtner, Strong, and Hensley (2006) have ascribed limitations to any undertaking.

According to Wright and McMahan (2011: 93-94) "...a number of strategy researchers have begun to address the relationship between a firm's human capital and its performance... In other words, strategy researchers have focused on the resource that may provide competitive [or service] advantage, but have provided little insight into how that resource may be acquired and developed..." seemingly overlooking the attributes constituting human capital, itself, in the process. There have been attempts to assess organisational human capital, where managers generated a standard human capital scale for assessing the work-performance of respective employees, such as; knowledge, skills, creativity, and other performance criteria (Takeuchi *et al*., 2007). However, the very approach emerging from Strategic Human Capital managers could be at odds with assessing the real complexities surrounding Health Human Capital regarding competencies in specialisations and sub-specialisations, workload, and work-environment among other performance factors. Effective measurement of healthcare service performance or quality of service could be better placed when the perspectives of the very expert service providers and clients/patients are incorporated, which Evans *et al*. (2006: 43) acknowledge "...should be an important part of health system executives' agenda".

2.4.1.2. *The Skills Formation Model*

The Skills Formation Model is a useful unifying framework that encompasses several learning concepts derived from childhood learning theory, *viz.* that skills are built on earlier skills; that development occurs in multiple stages; that human development entails the interaction of 'nature' and 'nurture'; and that human capital competency and skill are multi-dimensional.

The Skills Formation Model recognises the developmental upbringing and learning (of childhood) to be supportive of consequent (adult) stages of skills formation. The Model acknowledges the multiple factors, including such elements of general welfare as the health needs of the learner, that form part of the input towards the promotion of enabling conditions for skills acquisition. This developmental characteristic suggests human capital to be a set of requirements, viewed from the perspectives of the individual, his/her experience and cognitive, affective and psychomotor perspectives. Appreciation of such a range of perspectives enables the modelling of organisational policies so as to be able to identify which desirable skills formations are to be developed, at which point in the future and for what determined purpose (Psacharopoulos and Woodhall, 1997). Such a concerted and holistic model of skills formation is thought to be a positive driver of economic returns on investment and to be beneficial to members of the society at large. The inclusive nature of this model suggests that expenditure on education and training would be costly, but justifiable as a direct investment towards increased revenue and socioeconomic benefit to the society.

For continued professional development to match advances in technology and changing societal needs or expectations, self-regulating/enhancing competency-based attainments need to be considered beyond conventional skills formation of attainment. Whilst there may be focus on skills formation that would determine career choices and pathways, Madsen (2012) identifies health as highly influential for learning and the ability to effective innovations and earnings. The influence can be appraised at levels of individual, household, and nation in terms of health status to learn and/or earn income and consequently income status to fund learning, livelihood and cost of healthcare services. While influence of health on education, innovation and productivity for economic growth

could be given a general emphasis, there would be important need to addressing specific constituents behind optimum healthcare that positively contributes to uplifting household incomes and consequently national economic standing in a given situation.

The University of Wisconsin-Madison Institute for Research on Poverty (2005) observes that human capital is produced over the life cycle by families, schools, and firms, although most discussions on human capital have focused on schools as the major producers. A far more promising approach to undertake studies of mechanisms and institutions that facilitate production of skills and competencies is suggested. For example, as to whether the radiographic competencies are gained in a college/university setup and/or hospital clinical area would be critically considered in aligning supportive investment. This approach should shape the processes involved in skills formation and motivation for onward competency-based progression on expert-driven platform to inform appropriate policy formulation on Continued Professional Development intentions. Tikly (2003) upholds that skills formation policies and priorities need to be linked to a clear agenda of participatory, poverty eradication and social justice with local implications and/or foreseen benefits, which Pittilo, Morgan and Fergy (2000) termed programme specifications with clarity to supply fit healthcare workforce for intended practice and purpose.

2.4.1.3. *The Growth Accounting Model*

The Growth Accounting Model is closely linked to *per capita* income, reflected as the annual individual income of the population, derived from the yearly national income, or Gross Domestic Product, divided by the number of people constituting that population (Dipietro and Anoruo, 2006). In the Growth Accounting Model, the proportion of real income growth *per capita* that could not be attributed to growth in the quantity of capital and labour inputs is termed, 'residual income' (Solow, 1957). Even where this is relabelled as 'technical change' or 'efficiency', much of the observed economic growth is not attributable. Successive developments of the model have thus, increasingly, focused on the role of quality of inputs, including human capital, on the growth process (Schultz, 1960).

Later studies have attempted to show that a significant proportion of the 'residual income' factor can be accounted for by substitution of lower quality inputs with higher quality inputs (Bishop, 1990; Rastogi, 2000). Such substitution, however, has posed considerable difficulties in the definition of measurement and the comparison of skills and competencies. Furthermore, the differentiation of the quality of skills or competencies was further hampered by the associated challenges of defining the routes of causation, such as the scope of education and specific competencies that have led to improved growth (Becker, 1992; 1994). Despite these limitations, these studies have been seen to have provided useful benchmarks for the contribution of education to economic growth. Consequently, the new economic growth literature is replete with references to the contribution of education and training (Gemmell, 1995) and in which education and training, and its spillover effects, are placed at the heart of self-sustaining growth. In this respect, two major strands of thought, unable to be distinguished by empirical evidence, have emerged, in which human capital is simultaneously seen as an input towards economic production or service delivery that influences the level of output and growth rate or productivity, and the primary source of innovation, through its capacity to increase individuals' ability both to produce technical change and to adapt to it (O'Connell, McNeely and Hall, 2008).

Growth Accounting Model research concludes that human capital accounts for a significant overall productivity growth (Griliches, 1997) arising from the increased levels of competency within the workforce. This same research, however, emphasises the need for the meticulous measurement of educational quality, as this is relevant to an output goal. The research notes also that primary and secondary education skills are indirectly linked to productivity growth, in that these skills serve to underpin those tertiary educational skills that are most closely linked to economic growth (Gemmell, 1995). There is, furthermore, increasing evidence that research and development activities contribute significantly to the growth of organisational productivity (Lewin, 1946; Marimuthu, Arokiasamy and Ismail, 2009). The sought-after improvement in productivity and competitive edge, in this sense, is seen to transcend the organisational hub and exerts considerable effect in uplifting the community as a function of the improved quality of the resultant goods and/or services (Blundell *et al*, 1999).

Critics of the investment associated with human capital development theories argue that it is difficult to separate human capital investment from personal consumption. Olaniyan and Okemakinde (2008: 158), as educational managers, lamented that "the paradox accompanying this belief *[that investment in education promotes economic growth]* is that, despite the huge investment in education, there is little evidence of growth-promoting externalities of education in Nigeria". These authors further acknowledge that effective output from human capital investment also requires organisational structural reforms that optimise the resultant capabilities of those in whom the investment is made and facilitate externalisation of the benefits to the society at large. The human capital development models do not obviate the need for physical capital which plays an equally important role in yielding increasing productivity in goods or services (Murphy, 2008; Henwood, 2003). Investment in education and training has been observed to yield increased benefit when such investment is matched with parallel investment in research and capital equipment. Gemmell (1995), however, asserts that the primary source of technical innovation and increased institutional capacity to adapt to changes in the interests of improved service delivery lay in increased human capital capabilities.

Where income growth in a service institution is interpreted in terms of an institution's available income to better service provision, then the acclaimed 'capital and labour inputs' need to be defined. Aghion and Howitt (2007:79) recognise capital and labour inputs as "...production technology and capital accumulation…" to meet ways of improving the output. Frogner (2010: 361) ascribes "discussions about technology in healthcare [focusing]...primarily on investments in physical capital (e.g. MRI and CT machines), productive innovations (e.g. health information technology) and the development of procedures (arguably a form of physical capital)..." without inclusion of human capital, as erroneous. Radiography practice is part of healthcare service industry, which "...relies heavily on a human touch or, more formally, human capital inputs. Despite the large role of labour, an economic analysis of human capital and its role in health spending is absent from the literature…The investment in training people to carry out health-related procedures or to use, for example, imaging machines is missing from the literature" (Frogner, 2010: 361-362).

2.4.1.4. *The Applicability of Capital Development Models to the Study*

In the researcher's evaluation of models in terms of the objectives of the study, the Strategic Human Capital Management Model was appreciated to be a comprehensive and goal-driven approach to managing human capital. Its success however, was understood to depend on the nature and character of leadership within the organisation in which it is to be applied. In this respect, it is understood to be difficult, if not impossible, to implement within the context of an externally-driven research project. Its feasibility as a theoretical framework to guide a study of this nature is, therefore, questionable.

The Skills Formation Model makes reference to a number of widespread factors operating at multiple levels and requires a considerable amount of time to implement and evaluate the benefit derived as an output goal. This model, involving a series of levels, is not conducive to implementation within a limited timeframe. The Growth Accounting Model was seen to place emphasis upon increasing excess revenue, or profit, through an increase in skills and innovations. This model, too, was deemed to be inappropriate as a framework to guide this study, which is concerned with a specific range of capabilities sought to address a clearly identified service delivery gap. Advances in physical capital and productive technologies would require parallel human capital advances to satisfy technology-competency complementarities.

2.4.2. The Theoretical Framework

A theoretical framework was sought to provide empirical coherence and to inform the approach adopted in the study as an underpinning philosophical stance. In his summary interpretation of a theoretical framework, Zeidler (2009) points to a theoretical framework as a guide to addressing two basic questions in an enquiry, *viz.* (a) isolating the research problem or question and (b) justifying the research findings as a feasible solution to the research problem. In this way, the theoretical framework may be seen to serve as an intermediary theory, aimed at linking all the key aspects of the inquiry.

In reference to the extent of the previously described increase in the demand for radiological procedures worldwide, Quinnipiac University (2009) quoted an increment of

40 percent between 2000 and 2005. Such an incremental increase in demand, underscores the gravity of the functional absence of a radiologist's services since all radiological investigations, essentially, require a radiologist's input. The availability or non-availability of the required radiological competencies, would have a profound impact on a number of important clinical variables, *viz.* (a) the early detection of disease and a necessary component of health promotion directed at the economically active work force, (b) the optimal provision of radiological services, accessible, in terms of finance and location, to all citizens, including those in rural households, (c) the justification of cost-effective radiological technology, coherent with the expertise and desired accuracy to be found within the field of radiology, and (d) service-centred CPD and effective professional communication between clinicians and radiology departments.

This study was guided by a modified version of the Accenture Human Capital Development Framework (Thomas, Cheese and Benton, 2003). The model was modified in recognition that, as the Business Model of Osterwalder (2004), the Accenture Human Capital Development Model was designed for the business environment. The modification was made in order to suit the model to the focus of this study, which is within the public health service and having specific reference to radiological services in a rural setting.

The Accenture Human Capital Development Framework (AHCDF) was developed as a measurement system for effectiveness of an organisation's human capital processes and to determine the impact of each process (Thomas, Cheese and Benton, 2003). The element of AHCDF which is at odds with the purposes of this study is the significance it places on the direct link between the organisation's investments in people or the workforce and its business results. Within the context of this study, the notions of business results or bottom line were replaced with client satisfaction and quality of services provided to those rural communities who were served within the healthcare facilities that were included in the study. The focus in this study, therefore, was not on the pecuniary advantage to the individual radiology departments nor their associated healthcare facilities. The citizens were seen to be the principal beneficiaries, as they would be saved from the currently excessive cost of accessing scarce radiological services once service accessibility is improved. This view would further understand service delivery gains to serve as a simultaneous contribution to poverty reduction. Cognisance was also taken of Becker's

work (1994) regarding the investment in human capital, in which education, training and medical treatment are seen to be a means of investment in the national human capital, in this case, by the Zambian Government. It was conceived that specific and focussed investment in the extension of radiographers' roles would represent an indirect investment in the Zambian human capital as a collective entity.

Thomas, Cheese and Benton, (2003) acknowledge the difficulties associated with measurement of outcome following investment in human capital. The difficulty arises in the reality that the development of people and the company's financial performance are not always seen to be in a direct cause and effect relationship. Notwithstanding, there does appear to be some evidence to suggest that companies that do invest in human capital management tend to show better financial gains (Thomas, Cheese and Benton, 2003). Furthermore, from the AHCDF's perspective, measurements of gains derived from human capital development should be based upon a meaningful operational and investment perspective. The AHCDF proposes to be able to provide answers to the question of the identification of future areas of investment. Within the specific context of this study, this would include the question of the nature of the frontline radiographic knowledge and skills that would be needed in order to achieve the goals of Zambia's National Health Strategic Plan (2005), with specific reference to the provision of equitable and comprehensive radiological services to all Zambian citizens.

The AHCDF focuses on preferred practices in human capital development and learning in order that an individual organisation is able to evaluate its strengths and weaknesses in terms of key human capital processes. The resultant interventions are then able to be targeted towards yielding the greatest overall positive impact on the organisation's business or service result (Systems Application Products in Data Processing Company, 2005; 2006). The framework uses four distinct measurement levels, or tiers (Thomas, Cheese and Benton, 2003). These tiers assist in the determination of human capital practices that culminate in those attributes that most notably influence the relationship between the organisation's human capital assets and its financial or service performance.

The framework, as it is represented in Table 5, below, shows Measurement Factor Attributes as reference scale benchmarks, applicable in the evaluation of those human

capital factors that have the greatest value in terms of the well-being of an organisation and its output. The assessment of collected data, which may be reflected on a scorecard, is able to be represented as numbers, percentages, opinions, or graphs (as in descriptive statistics) and matched against the organisation's established benchmarks for the desired business or service output.

Table 5: Human Capital Development Framework
(Thomas, Cheese and Benton, 2003)

REFERENCE TIERS	MEASUREMENT FACTORS	MEASUREMENT FACTOR ATTRIBUTES
Tier 1	Business or Service Result	Organisational success, such as; capital efficiency, revenue growth, return on invested capital, total return to shareholders, accessibility and cost of service.
Tier 2	Key Performance Drivers	Intermediate organisational outcomes, such as; customer satisfaction, innovation, productivity.
Tier 3	Human Capital Capabilities	Most immediate and visible people-related human capital qualities, such as; employee engagement, technical skills and adaptability.
Tier 4	Human Capital Processes	Specific practices and/or activities undertaken for robustly comprehensive or optimum and effective human capital capabilities, such as; skills appraisal, education, training, medical welfare and competency management.

The researcher identified the AHCDF as a framework that provides derivable substantive concepts of Health Human Capital Development (HHCD) appropriate to the advancement of diagnostic radiography practice, as the central focus of the study. The lack of an established conceptual basis for the measurement of human capital investment within the healthcare sector has been known to hinder the strategic inclusion of human capital investment in financial plans (Gates, 1984). There is a need to promote an understanding of health investment that incorporates human capital development within its understanding of healthcare costs. Such expenditure would be an investment in health promotion, in contrast to those costs associated with the treatment and management of illness. An appropriate and focused emphasis on human capital development in the health sector (Health Human Capital) would also be consistent with the aspirations of the World Health Organisation (Nakajima, 2006).

Although Health Human Capital (HHC) is embodied within individual healthcare practitioners, such an asset, as it is, exists only by virtue of the knowledge and skills that arise from direct investment in education and training, as opposed to other investments in healthcare. This distinction is critical to the determination of those institutions through

which investments towards Health Human Capital Development would be made. Murphy (2008) realistically cautions that factors besides mere curriculum design, such as the galvanizing of essential learning content into appropriate knowledge and skills, and embedded versatility sufficient to allow for adaptation to challenging circumstances, are worthy considerations in the identification of future sites of HHC investment. She further identifies trainer skills and motivation, training facilities and equipment, and institutional support as important factors (Murphy, 2008). Such considerations call for a pragmatic collaboration among relevant Government ministries and departments or private institutions where, particularly in cases, such as is seen within the Zambian context, Health Human Capital Development falls outside of the sole mandate of the Ministry of Health.

The AHCDF (Cheese and Thomas, 2003) provides an indirect measurement concept that may be applied to healthcare-related activities that affect radiological service delivery. The upliftment of the radiological capabilities of local departments was conceived as a means of poverty reduction within surrounding communities, in terms of the earlier discussion around the economic impact of accessing widely dispersed radiological facilities. In addition, the researcher has identified ethical and clinical concerns around the status quo, in which radiological investigations are fundamentally restricted.

The focus of this study was, therefore, to investigate a mechanism by which the existing high level of basic education of radiographers, supported by advances in diagnostic radiographic practice, may be harnessed in the extension of roles towards that of the traditional radiologist. The study, however, did not seek to conduct direct measurement of losses or gains in household expenditure as a result of the intervention advocated in the study. Notwithstanding, it was envisaged that a limited number of monetary variables could be inferred from the data on Service Result and Key Performance Drivers.

Table 6, below, tabulates the application of the Frontline Radiographic Human Capital Development as a modification of the Accenture Human Capital Development Framework (AHCDF) as depicted in the preceding table, Table 5.

Table 6: Modified AHCDF with Radiographic Human Capital Development Attributes

REFERENCE LEVEL	HUMAN CAPITAL CONCEPT	MEASUREMENT FACTORS (Subject to benchmarks)
Service Result	Organisations success	Accessibility of service, cost of accessing service, cost of providing service.
Key Performance Drivers	Intermediate organisational outcome	Quality of Service, Innovation and Productivity, Client satisfaction.
Human Capital Capabilities	Most immediate and visible or evident people-related qualities	Technical skills, adaptability to work demands, employee engagement.
Human Capital Processes	Specific practices or activities for robust radiographic human capital capabilities	Career development, education and training, competency management, workforce planning and recruiting, radiographic role extension and licensing.

Development of appropriate radiographic human capital in healthcare can be seen as an underpinning factor towards optimum radiological services in the Zambian setting, equitably accessible to both urban and rural communities. The objectives of this study were concerned with: (a) existing radiological services, or radiographic practices, in rural Zambian hospitals without radiologists, (b) adequacy of radiological service delivery without radiologists, (c) frontline radiographers desirable competencies for comprehensive or optimum radiological service delivery, and associated benefits to communities and health service facilities, (d) appropriate frontline radiographers' capabilities for optimum radiological technology and services despite the lack of radiologists, (e) client satisfaction with radiological services and, (f) development of a frontline radiographic human capital development theoretical framework for continued radiological service improvements. A special focus on radiological settings without radiologist, mainly in rural-based healthcare settings associated with low incomes, also underscores the attention placed on the cost of accessing scarce and distant radiological services. The scope of this study sought to remedy the threatened aspirations for early detection of disease and poverty reduction espoused in Zambia's Sixth National Development Plan on health (Ministry of Finance and National Planning, 2011) and related United Nations Millennium Development Goals (United Nations, 2000). Within this context, the researcher acknowledges the counsel of

World Health Organization (2007) advocating healthcare practices responsive to the needs of people concerned.

CHAPTER 3
METHODOLOGY

This Chapter describes the approach adopted towards ensuring the successful progress and completion of the research study. The methodology is described in terms of the study design, the setting, the selection of participants, the research tools, data collection and data analysis in each phase. The academic rigour, reliability and validity, and research ethical considerations are also described.

3.1 DESIGN

A four-phase action research study was conducted towards the development of a framework for radiographic human capital development aimed at improving access to radiological healthcare in areas without the services of radiologists. Multiple methods of collecting data were used, including semi-structured interviews (Phase 1), document analysis (Phase 1) and questionnaires (Phase 2, 3 and 4).

Greenwood and Levin (2007) have defined Action Research as a set of collaborative means of conducting social research that simultaneously satisfy the scientific requirements, whilst promoting positive democratic social change. Action Research enables the reframing of a position for the survival, or maintenance of service delivery, based on a collective knowledge generation process that adopts an active problem-solving strategy. In endeavouring to resolve the radiological service delivery problem, in this case, the generation of scientific knowledge, for incorporation into action designs, involved both healthcare practitioners and patients, as partners in service delivery and as mutual contributors to a continuous developmental process. Reason and Bradbury (2002) similarly define Action Research to be a form of quasi-experimental research that focuses on the actions of practice and the quality of the intended goal in a real world context.

When Lewin first introduced Action Research in 1944, he defined Action Research (Lewin, 1946) as a comparative research on the conditions and effects of various forms of social action and research that leads to social action to support, or remedy, the status quo.

In his discussion of Action Research, McNiff (2002) emphasises the use of a spiral of steps, composed of systematic cyclical processes, *viz.* (a) a stage of planning, comprising the gathering of data; (b) a stage of taking action for improved service delivery; and (c) a stage of evaluating the result of such action.

In the context of this study, Action Research approach involved a cyclic process *[see Figure 1]* in which the first three phases, *viz.* diagnosing, action planning, and action taking were central to defining the principal thrust of the study. A fourth phase, that of evaluating, was concerned with the determination of the quality of the action taken. These four phases allowed for the building and strengthening of the scientific knowledge, and the development of a framework, from which an approach towards providing radiographic service delivery in healthcare settings without the services of a radiologist could be used. The educational and organisational outcomes were expected to inform an iterative framework to guide ongoing radiological service delivery improvements. The described cyclical phases (Susman, 1983: 95-113; O'Brien, 1998) are illustrated in Figure 1, overleaf. This phased cyclical research process was also closely linked to the research objectives *[see Appendix 1]*.

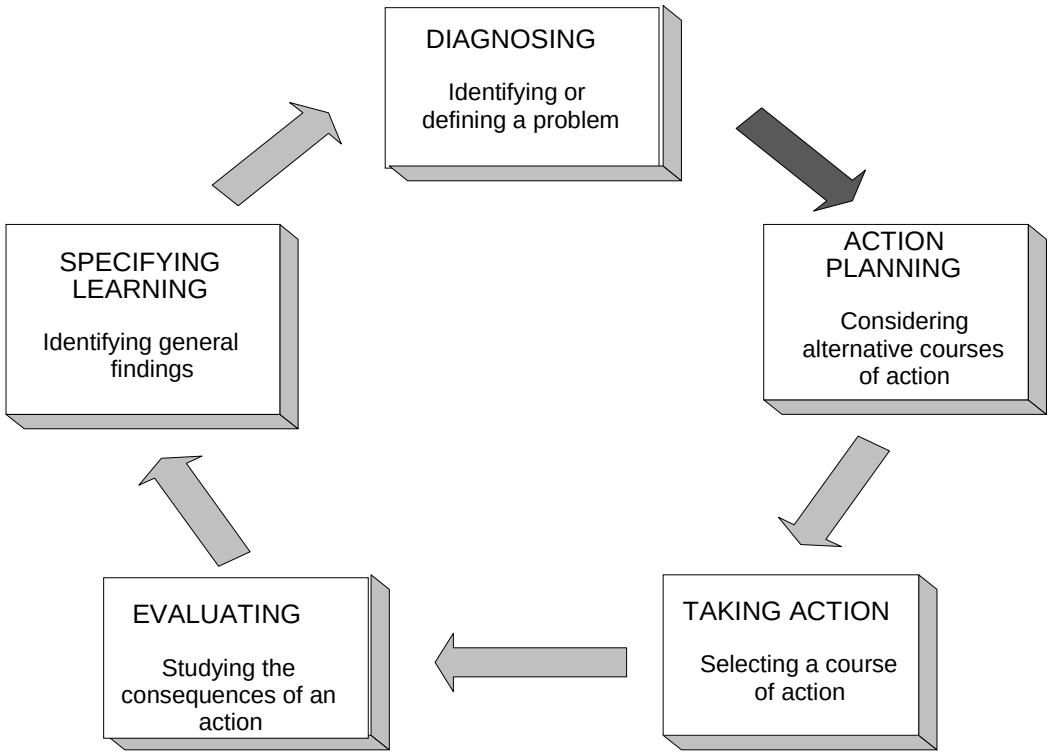

Figure 1: Action Research Process Route *(Susman, 1983; O'Brien, 1998)*

3.2 STUDY SETTING

This study investigated the radiological services of one rural Zambian province in which all the hospitals operated without a radiologist. The province that was selected as the study setting was the Western province of Zambia, predominantly a rural province, in which this researcher worked as a radiographer for five years at the commencement of his diagnostic radiography career in the early 1990s. According to Zambia's 2010 Census of Population and Housing (Central Statistical Office, 2011), the population of Western province was determined to comprise 881 524 of a total Zambian population of 13 046 508 people. The distance, by road, between the Western provincial headquarters, in Mongu, and the National headquarters, in Lusaka, is approximately 600 kilometres. The province covers an area of around 122 000 square kilometres, and comprises approximately 17 percent of Zambia. At the time of the study, the primary economic activities within the province included agriculture, fishing, tourism and forestry (Chintu *et al*., 2008). In their analysis of the provincial socioeconomic status, Chintu *et al*. (2008) found about 65 percent of

households categorised as extremely poor and, in meagre self-employment activities, hardly able or unable to pay for household essentials including foodstuffs, basic health and education.

For administrative purposes, the Western province was demarcated into seven districts, at the time of the study, *viz.* Mongu, Kaoma, Senanga, Sesheke, Shangombo, Lukulu and Kalabo *[see Appendix 2]* and was serviced by a total of eleven hospitals i.e. six Government hospitals and five Mission hospitals. Of these eleven hospitals, one Government hospital was a secondary referral hospital or general hospital, while the remaining ten hospitals carried primary referral status, and received referrals from widespread health centres and a few health posts. Appendix 3 illustrates the locations of healthcare facilities within the Western province. Table 7, below, summarises the nature of communication modalities and the distances by road between Lusaka and Mongu (as provincial capital), and Mongu and respective district headquarters.

Table 7: Communication Modalities Linking Lusaka with Western Province

<table>
<tr><th>Destination</th><th>Distance by Road in Km</th><th>Most Common Mode/s of Access</th><th>Information & Communication Technology (ICT)</th></tr>
<tr><td>Lusaka to Mongu</td><td>600</td><td rowspan="3">By road, throughout the year.</td><td rowspan="8">Internet, landline phones and mobile phones are generally available. Periods of extended loss of communication also occurred.</td></tr>
<tr><td>Mongu to Kaoma</td><td>189</td></tr>
<tr><td>Mongu to Senanga</td><td>120</td></tr>
<tr><td>Mongu to Sesheke</td><td>310</td><td rowspan="3">4-wheel drive road access, in dry season only [August to October]</td></tr>
<tr><td>Mongu to Shangombo</td><td>200</td></tr>
<tr><td>Mongu to Lukulu</td><td>394</td></tr>
<tr><td>Mongu to Kalabo</td><td>73</td><td>4-wheel drive road access, in dry season only [August to October]. By waterways between November and July.</td></tr>
</table>

A research assistant, who was based in the Western province and recruited at the planning stage of the research project, closely worked with the researcher in the study from its preparation stages up to the end of the study. Through the research assistant, the researcher was able to reconfirm, at the planning stages, that there was no radiologist in any of the radiological sites included in the study. Additionally, the respective numbers of

physicians and radiographers were also able to be established. The physicians and radiographers were identified as the two categories of healthcare practitioners that were most closely linked to the provision of radiological services in those sites that operated without radiologists.

3.3 PHASE 1: DIAGNOSING

This phase took place within the Western province, and was concerned with identifying and defining the problem. Specifically, data collection and analysis at this phase was aimed at addressing the first two objectives of the study; i.e. to: (a) analyse the existing radiographic services and/or practices in rural Zambian healthcare facilities without a radiologist, and (b) examine the views of radiographers, physicians and patients/clients in hospitals without radiologists, regarding the adequacy of existing radiological service delivery.

3.3.1 The Selection of Participants

Participants for the first phase of the study included relevant healthcare providers and patients. The selection of participants involved in the healthcare provision was by purposive sampling. The selection of these participants was based on their respective expertise and involvement in either radiological practice, decision making and/or policy making within the provincial healthcare sector. All (n=69) practitioners who were working within the healthcare settings of the Western province at the time of data collection were invited to participate in the study. This consisted of radiographers (n=19), physicians (n=35), healthcare managers (n=8), clinical officers (n=5) and radiography assistants (n=2). The selection of patients was based on their previous experience with the radiology services in the Western province hospitals without the services of a radiologist.

The provincial radiology statistical data from six districts of Western province were obtained before the commencement of the study (Ministry of Health, 2009). These data showed the average number of patients who sought radiological services, and who had a history of previous radiological services, to be around 61 percent of the total number of patients presenting for radiological services within the province per annum (102 520). This

average was derived from a range of 35 percent to 85 percent, depending on the hospital referenced. This calculates to 62 537 patients receiving radiological services for at least a second time, within the study period. The target sample size was 10 percent of the estimated annual number of patients receiving radiological services for at least the second time [10 percent of 62 537 = 6 254 patients], at an average rate of 521 [n = 6 254÷12] per month. With rate of 521 patients per month, it was administratively arranged that every 5th patient be invited to participate. The targeted sample size for patients on a two months period was 208. This size would constitute 20 percent of the average number of the expected patients in the two months. This participating number of patients was seen as within the useful manageable limits without causing undue interference in the smooth running of healthcare services. The seventh district, Shangombo, had healthcare management and health centres, but was without a hospital or radiology department at the time of the study. Table 8, below, delineates the total number of patients with a history of prior radiological service per district.

Table 8: Number of Returning Radiology Patients per District *(Ministry of Health, 2009).*

WESTERN PROVINCE DISTRICTS	NUMBER OF RADIOLOGY PATIENTS IN 2009
Kalabo	10 900
Kaoma	12 570
Mongu	36 000
Lukulu	8 050
Senanga	10 000
Sesheke	25 000
TOTAL	**102 520**

Only those patients who had prior experience of radiology department services were invited to participate in the study.

Where the selected patient would be too ill or too young (below sixteen years old) to consent to participating in the interview, albeit rarely in this case, an accompanying relative (parent/guardian for children) would serve as proxy participant in the presence of the actual patient, subject to having a close relationship with the patient as an affected

family member. It was a requirement that proxy participants had their own prior experience of the radiological service. Rajmil *et al*. (1999) recommends patient's inability to comprehensibly participate in the interviews as justification for proxy participant. Caution in studies involving proxy participants, as Tennant, Badley, and Sullivan (1991) describe, relate to possible under-reporting of events due to lack of appropriate knowledge (proxy effect) and reporting more accurately only those events the proxy considers to be more relevant (salient principle). The characteristic of the questions asked and proxy participants' relationship with the patients were decisively taken into account for the representativeness of the proxy participants. Otherwise, there was no foreseen or applicable threat to representativeness of the data, which arose from cognitive questions that dwelt on patients' welfare and not the actual illness. Experiences directly linked to the patient's affective or emotional domain would have been challenging to articulate by a proxy (Rothman *et al*., 1991), unlike this study's interviews based on the provision of radiological services and related views. The selection of participants was determined by the inclusion criteria as well as exclusion criteria as, respectively, stipulated below.

3.3.1.1 Inclusion Criteria

All radiographers and physicians serving in Government and Mission first referral and second referral hospitals in Western province of Zambia were eligible to participate in Phase One of the study. The physicians, as participants, included respective heads of hospital. The healthcare managers at District Medical Offices and Provincial Medical Office were also invited to participate in the study. The clinical officers – reporting to physicians, and radiography assistants – reporting to radiographers were also eligible to participate in this phase. The patients who were accessing the radiological services for at least a second time at the time of conducting this study, qualified to take part in the first phase of the study. Prior experience by patients of the radiological services was an inclusion factor.

3.3.1.2 Exclusion Criteria

Student radiographers, student radiography assistants, medical students, and student clinical officers attached to the hospitals for mentorship and not yet qualified to practise

respective disciplines, as well as healthcare practitioners not acquainted with radiology service provision were excluded from participation in the study. This exclusion served to maximize the garnering of opinions based on professional exposure and expertise. Patients – including proxies - without prior experience of receiving radiological services were excluded.

3.3.2 Instrumentation and Data Collection

An interview schedule was developed towards facilitating semi-structured interviews with practitioners. The schedule for the semi-structured interviewing of practitioners, in this first phase, is reflected as Appendix 4. The interview schedule, in line with the theoretical framework, focuses on practitioners' views on (a) human capital processes – the prevailing radiography education and training and career pathing; (b) human capital capabilities – levels of employee engagement, technical ability and capacity; (c) performance drivers – productivity, the quality of radiological services; and (d) service result – accessibility to the services and client satisfaction. Since physicians were understood to base their expert decisions on behalf of patients on the results of the services provided by individual radiology departments, they were regarded as clients of radiology departments within the context of this phase or study, as well as being practitioners in their own right.

The patients' interview schedule focused largely on patients' satisfaction with the existing radiological services *[Appendix 5]*. The satisfaction parameters that were explored included: (a) the accessibility of the radiological services, (b) the efficiency of the respective radiology department, and (c) the nature of referrals for radiological services and the associated consequences.

The researcher and the research assistant who also served as second driver, travelled by road to the eleven hospitals included in the study, seven district medical offices and one provincial medical office. The total distance covered by road, i.e. from Lusaka to all the identified interview sites and back to Lusaka, was at least 5 436 kilometres and was accomplished within a period of two months. In this regard, prior planning was critical in terms of both the acquisition of a four-wheel-drive vehicle to suit the rough terrain and the timing of the fieldwork to coincide with the period in which routes are known to still be

passable by road. Table 7 (above) highlights terrain-related considerations that informed the timing of the fieldwork. In view of the passability of roads, and the remoteness of the research sites, the researcher also ensured that he was equipped with a surfeit of critical equipment, such as audio-recorders (2) and audio cassettes in excess of anticipated need.

All the interviews with the practitioners were conducted by the researcher and were audio-taped. Two audio taping machines were available throughout the field trips. The research assistant, who assisted in securing appointments for interviews, accompanied the researcher to all interviews. The data from the interviews was continually evaluated for conformity with the research objectives, and in terms of either continued new findings or conclusion due to data saturation. The duration of interviews was 30 minutes on average.

The researcher and the research assistant worked together in conducting the structured interviews with the patients. In view of divergent literacy levels, patient interviews were explained and conducted within the participating patient's preferred language. Both the researcher and research assistant were fluent in the spoken local languages in the province. The duration of patient interviews was 25 minutes on average. Patient interviews continued until no new information was obtained, i.e. data saturation was reached.

Document analysis was carried out in order to obtain data on the status of the existing radiological service, and its delivery and contribution to healthcare in the Western province of Zambia, as well as available avenues for development. The specific foci of this document analysis were: (a) the nature of referred radiological investigation; (b) the range of radiological examinations that were available at the time of the study; (c) the range of leading radiological requests; (d) the availability and/or adequacy of radiological reports; and (e) the radiology-related patient outcomes (i.e. treated, discharged, or referred). The radiology performance records, reports, and other relevant official documents associated with the radiological services and healthcare personnel were used as sources of data.

The document analysis guide to radiological service delivery, as contained in Appendix 6, guided the collection of these data within this first phase of the study covering the eleven hospitals in the province. In each case, the radiology performance data for the two months preceding the first phase, considered: patients' general residential address (not specific

address) to determine distance from the hospital and cost implications, nature of requested radiological investigation to appreciate justification for relationship with available role of radiology and service gap/s to consequent clinical outcome or referral (where applicable). The radiology patient registers were also analysed for types of radiological investigations handled, and most common x-ray examination. Other most recent relevant official documents pertaining to overall status, maintenance, and possible developmental plans of radiological services in the Province were accessed. These documents included: (a) Consolidated Performance Assessment for Western Province, (b) Technical Support Report on Radiology, (c) Key Strategy: Increasing the Number of Trained Health Workers in the [Healthcare] Sector, (d) Zambia's Sixth National Development Plan on Health, (e) ORET Project Report on Upgrading of Radiological Services, (f) National Health Services Act, (g) Health Professions Act, and (h) map of Western Province Healthcare Facilities.

3.3.3 Data Analysis

All the audio taped data from the practitioners were serialised and coded in accordance with source of data in terms of institution and participant category, which corresponded with word processed datasheets arising from the transcriptions. The hand written data from patients' interviews were also word processed to facilitate close analysis by thematic clues. In addition, frequency counts and percentages were computed for patients' data to determine the distribution of participants' opinions. The transcribed and word processed interview data facilitated the identification of themes, and patterns in relation to the study's theoretical framework. The document analysis data were corroborated with interview data.

Approaches to data analysis may vary according to the discipline of research and respective analytical traditions. Bradley, Curry and Devers (2007) recommend the generation of taxonomy or the classification of data and themes that are relevant to the theoretical framework as being appropriate to the qualitative analysis of data within health services research. This view is echoed by Ratcliff (2009). In this phase, the various forms of data were classified and clearly delineated in order that empirical evidence could be effectively focused towards the definition of the status of radiological services and associated views, guided by the theoretical framework.

The data generated were continually evaluated, through brief research notes, to determine patterns and completeness of emerging data in relation to research objectives. This evaluation of data, as research progressed, also aided to monitor the attainment of the intended number of participants, and the achievement of appropriate levels of data consistency. In this way, a modicum of preliminary analysis was effected, at selected intervals, in order to keep pace with the emergence of data saturation, or towards the identification of a need for further triangulation of the data. The preliminary data analysis soon after this first phase guided the focus of the self-administered questionnaire required in the second phase of the study.

3.3.4 Pilot Study

A pilot study involved the researcher's preliminary trip from Lusaka to Western province to plan the execution of the field work with the research assistant based within Western province. At this stage all the tools for use in the first phase, including the audio recorders, were assessed and tested, with the research assistant, for readiness to commence data collection. The pilot interviews were conducted with three practitioners within the research sample. During this process the need for advance notification for interview appointment with the practitioners was noted so that the appointment times and venues for interviews became the practitioners' preferences. Prudent ways of collecting data without foreseeable distraction, including a serene interview environment that promoted smooth interview process and recording, were considered. In order to ensure confidentiality, a conscious or deliberate effort was made not to address the participants by their names throughout the interview processes. Ways of intermittently confirming the functionality of the audio recorder and recording time limit of the audiotapes was considered and devised as it would be unworkable to repeat any interview in case of recording failure. Other areas of note included allowing about thirty minute intervals between each interview for the researcher and the research assistant to listen to the played back audiotape to confirm audibility and clarity of interview. During this time the researcher would reflectively prepare interview-based hand written analytical notes in relation to the theoretical framework and planned dataset entry.

Furthermore, the pilot interviews were conducted with five patients. It was noted that indeed some patient participants would need to endorse the consent forms by thumb as provided for in the consent form [see Appendix 15] and, therefore, required an ink pad throughout the field trips. Confidentiality in handling all the data was addressed, including the reassurance that the identity information in the consent forms would remain confidential.

The research assistant, who held university degree in developmental studies, was conversant with means of transport to all districts in the province. The researcher spent at least one week with the research assistant in the province to outline the research plan and train the research assistant on his roles. Thereafter, debriefing sessions would be used to strengthen his skills as the project progressed. The roles included, assisting in arranging appointments for interviews, data collection, data entry, and data management. The researcher provided tuition on ethical, communication, and interpersonal aspects, including interaction with participants of multidisciplinary and diverse cultural backgrounds as applicable in the project. Practical or hands-on training was also provided in the use of research equipment and computer applications, such as audio recorders and Microsoft Excel, for effective data collection, management and analysis. The research assistant observed the interviews, conducted by the researcher, with three practitioners and two patients and satisfactorily interviewed the three patients under the researcher' observation. Instructions on precautionary measures for correct entry of data and counterchecking with the researcher were provided, as well as ways of maximising protection of data storage against loss or unauthorized person/s.

The guiding tool for document analysis was piloted among heads of radiology department at the second referral hospital, one district hospital and one Mission hospital and the manner in which ethics would be upheld in the handling of data was addressed. For example, the research report would ensure that names of participating hospitals could not easily be linked to particular responses. All the approval documents to carry out the research would be orderly arranged for easy access whenever required.

3.3.5 Academic Rigour

Triangulation is one important way of strengthening a predominantly qualitative study design (Patton, 1990). Literature identifies four types of triangulation (Denzin, 1988; Robson, 2011). Triangulation is seen as a valuable strategy to improve rigour. The four types of triangulation are known as: (a) data triangulation – use of several data collection methods, (b) observer triangulation – use of more than one observer, (c) methodological triangulation – combining qualitative and quantitative approaches, and (d) theory triangulation – use of multiple viewpoints. With reference to the four types of triangulation described above, this study involved: multiple sources of data such as patients, multidisciplinary practitioners, and hospital or departmental records. In addition, several data collection methods were used, including interviews and document analysis.

The data collection tools and/or methods were piloted, as earlier shown. From the outcome of piloting, the general approach to posing interview questions was adapted to reduce ambiguity of interpretation, and to improve the quality of the resultant data. The management of the interviews, furthermore, was streamlined so as to ensure individual completion within a projected 30 minute timeframe. Additionally, the preparation of dataset tabulations associated with the theoretical framework was improved post-piloting.

The guiding tool for document analysis *[see Appendix 6]* had a provision to source additional compelling data, as in documented official information outside the confines of the radiology departments or hospitals, related to the investigated subject of healthcare provision. For example, the Health Professions Act 24 of 2009 (Republic of Zambia, 2009: 258-359) was sourced under the cited provision. All sources for document analysis were based on original documents.

3.3.6 Ethical Consideration

The guiding ethical principle remained; not to harm or cause harm to the participants, or participating institutions, as a result of their participation in the research (Colquhoun and Kellehear, 1993; Oppenheim, 1999). Such referred harm could arise in the form of

physical harm, emotional injury or distress, or injury to the respective institutional reputation.

The success of the study from the onset, as anchored from this very first phase, was contingent upon the sensitive handling of all participants and the support of institutions towards carrying out the study. The study had to go through relevant approving authorities, and these approvals needed to be confirmed by the responsible official hierarchy up to the participants. In this respect, a copy of the certificate of ethical approval of the study by Durban University of Technology is included as Appendix 10. Since the study was to be conducted in Zambia, the necessary approval from the University of Zambia is included, also, as Appendix 11. Further approvals were obtained from the Zambian Ministry of Health *[Appendix 12]* and the Western Provincial Medical Office *[Appendix 13]*, in view of the focus area of the research falling within the ambit of the Zambian Ministry of Health and Western province. The researcher made an initial courtesy trip to the Western province of Zambia to introduce the research project's aims and objectives to the Provincial Medical Office prior to the first data collection phase, and received relevant counsel on organisational protocols.

The researcher's identity was consistently and explicitly revealed to the relevant authorities and all participants. All participants were informed of the nature of the study, with the aid of an Information Sheet *[see Appendix 14]*. The Information Sheet highlighted the nature and scope of the study, including the projected benefits, which the researcher verbally elaborated to prospective participants, where necessary. A consent form for voluntary participation was provided, with the explicit provision made for participants to withdraw at any stage if so wished, without prejudice and without any need to explain or justify the withdrawal. The consent form had a provision of the thumbprint for patient participants, who were not able to sign their own names. The documented consent to participation, as an agreement between the participant and researcher, was witnessed to by the research assistant, who also endorsed the consent forms. The consent form used in the study is appended as Appendix 15.

For purposes of confidentiality, measures were taken to protect the anonymity of participants through data collection tools and reports. In this regard, only the broad generic

categorisation of the participant, such as 'radiographer' or 'patient' was reflected. Furthermore, the data for document analysis focused on themes or subjects linked to the study's theoretical framework, without any disclosure of patient or practitioner identity and with due regard not to cause malice to individuals or institutions.

Protection of the participants from harm or discomfort exacerbated by research activities was also viewed in the ethical perspective (Dawson, 2009). The health status of the patient participants was evaluated accordingly so that they were not delayed by the interview or seen to be inconvenienced. Similarly, the practitioners' service to the patients took precedence, so that interviews were occasionally deferred for practitioners' ongoing services to patients to proceed uninterrupted. All the participants were understood to be engaged with accomplishing their respective undertakings. Therefore, particular attention was paid with respect to ways of accomplishing data capturing exercises in the most efficient and least disruptive manner, including managing the forecasted time of within 30 minutes for the interviews.

3.4 PHASE 2: ACTION PLANNING

The objectives of the study in this phase were to: (a) determine desirable competencies for frontline radiographers in comprehensive radiological services delivery, as well as benefits of such competencies to the community and health service facilities, and (b) analyse the managements' expectations regarding frontline radiographers' capabilities in rendering comprehensive radiological services in healthcare settings without radiologists.

3.4.1 The Selection of Participants

For this second phase, a purposive sample of professionals, including managers, was invited to participate in this study. It was believed that this group would be more knowledgeable about the phenomenon of interest at this stage, which was to obtain data that would inform the planning and designing of a programme of action aimed at dealing with some of the gaps of the Western province radiological practice identified in the first phase of the study; specifically as these relate to frontline radiographers' competencies.

The data obtained from the first phase being a prerequisite to the scope of this second phase 'action planning' in the action research process, a broader range of expert opinions were required, outside of and beyond the limitations of the Western province, and representative of a broader range of parameters *viz.* application of service, policy, regulation and regulating frameworks, education and training surrounding radiological service delivery and radiography practice.

The selection of participants was guided by the technical nature of sought input, thereby necessitating invitation of all practitioners known to be potentially and/or directly involved in determining national radiological service delivery by virtue of their expertise. Clinical officers (n=5) and radiography assistants (n=2) were excluded from participation at this stage. It was believed that as these categories worked under supervision of physicians and radiographers, respectively, the physicians and radiographers would be better placed to provide the information required at this phase of the study. Hence, only 54 of the 61 practitioners who participated in the first phase of the study were invited to participate in the second phase.

In addition, 18 practitioners deemed knowledgeable about the information sought at this stage were included for participation. These 18 selected participants were; radiography lecturers (n=5) based at a training college, radiography clinical instructors (n=4) and radiologists (n=2) serving at tertiary hospitals, Health Professions Council of Zambia officials (n=2), Radiological Society of Zambia officials (n=3), a National Imaging Specialist (n=1) and a National Training Standards Director (n=1). All these 18 additional participants were based in Lusaka, due to their types of work. In all, 72 participants were included in the second phase.

3.4.1.1 Inclusion Criteria

The selection of participants, above, was determined by the categorised inclusion criteria or decisive factors. All the radiographers and physicians as in first phase were eligible to continue with their participation in this second phase of the study. The physicians, as participants, included respective heads of hospital. The healthcare managers at District Medical Offices and Provincial Medical Office were also invited to continue with their

participation in the study. Other participants included were practitioners involved in expert varied roles pertaining to National radiological service delivery. These practitioner participants, additional to those that participated in the first phase, included radiology policy advisory or technical position in Ministry of Health, National Training Standards, Radiological Society of Zambia, as professional body, and the Health Professions Council of Zambia, as licensing authority under the Health Professions Act 24 of 2009 (Republic of Zambia, 2009: 258-359). Others were all the available radiologists, as well as radiography lecturers. The radiography clinical instructors at the two third referral hospitals in Lusaka; University Teaching Hospital and Cancer Diseases Hospitals, where student radiographers receive clinical training were also eligible to participate in this category of participants.

3.4.1.2 Exclusion Criteria

Visiting practitioners were not expected to be immediately familiar with the specific challenges of radiological service delivery in Zambia in general and/or rural Zambia such as the Western province. Such practitioners were excluded in this second phase of the study. Similarly, radiographers, physicians, healthcare managers who might have commenced work in the Western province after the first phase of the study were excluded from the second phase of the study. Clinical officers and radiography assistants were excluded and represented by professionals to whom they reported; physicians and radiographers, respectively. The patients as external clients were also excluded in preference for expert opinions or technical representation from physicians who, as internal clients of radiological services, made technical decisions, including radiological requests to radiology departments on behalf of patients.

3.4.2 Instrumentation and Data Collection

Data emanating from the first phase of the study were used to design a questionnaire for data collection in this second phase. Specifically, the focus was on what could be feasibly carried out within the constraints of a research project with limited resources. Acknowledging that for the most part, Phase One participants had identified a number of gaps as well as desired changes in Western province radiological service delivery, the researcher had to determine the feasibility of the various options raised by the participants

in the first phase. Specifically, the participating patients had, in some cases, raised issues related to the quality of machinery, waiting time and radiographer/patient communication. The researcher needed to cautiously differentiate between the patients views on the status quo and what actually were their 'suggestions towards improving radiological services'.

Decisions related to what is feasible under these circumstances had to be made. Hence, a short questionnaire focusing on only three areas of possible improvement was developed. The researcher was mindful not to create idealistic expectations, which he could not meet. The questionnaire's three questions basically interrogated the feasibility of introducing the traditional roles of radiologists in the Western province in the light of inadequate number of radiologists countrywide and need for other experts to participate in planning a feasible solution. Firstly, could the solution lie in visiting radiologists, extending radiographers' roles, or other solution? Secondly, could the solution be in a diagnostic reporting educational programme for the radiographers, or other solution? Notably, as illustrated in the first and second questions, an open option for "other comment" was provided in each case. Furthermore, the third question was open for the participants to express their remedial opinions in priority order. The questionnaire consisted of: (a) closed-ended questions (1 and 2), (b) open-ended questions (1 and 2), and (c) open-ended question 3 on identified 'three priority workable solutions' in order of priority. The self-administered questionnaires that investigated these parameters were mailed to the 72 second phase study participants. Each questionnaire included prepaid self-addressed envelope to facilitate response and delivery by courier service. The questionnaire is included as Appendix 7.

3.4.3 Data Analysis

Analysis of data obtained from this second phase of the study was subjected to quantitative analysis, with qualitative analysis also applied, where appropriate. For example, the data obtained from open-ended questions in the questionnaire *[Appendix 7]*, were transcribed and analysed for patterns and themes. Frequency counts were then computed to determine the most commonly appearing themes *[see Figure 2]*. In this regard, the processes of data analysis involved: (a) patterning or noting of occurring patterns or themes, and (b) clustering or grouping of features with similar meaning. Questions 1 and 2 sought both

closed-ended and open-ended responses, whereas question 3 sought only open-ended responses.

In these analyses, various aids to analysis were utilized, including the application of session summary sheets and coding. For example, the transcription in Appendix 8 was colour-coded to facilitate the determination of themes, and identification of commonly occurring themes. Word processing was advantageous in storing, organizing, and keeping track of data for analysis and display. Microsoft Excel was used in organizing some quantitative data and illustrating the results in Figure 2. Whilst specialist software such as NVivo could have been applied to organize the qualitative data for analysis, the researcher found varying open-ended opinions requiring closer interpretational emphasis. With regard to advantages and disadvantages of specialist qualitative data analysis, Robson (2011) acknowledges the need for harmonized focus on coding and other technical aspects, but as well as emphasis on researchers' interpretation of data.

3.4.4 Pilot Study

The questionnaire was initially discussed with at least two lecturers in health sciences, as workmates, and the research assistant on the basis of clarity of questions and what each question sought to achieve from the participants. The two lecturers reviewed the responses in aiding assessment of reliability. The questions needed to be compelling to both the earlier participants and new participants that joined the study at this stage, to increase chances of response rate. According to Flanigan, McFarlane and Cook (2008: 4143), among other considerations, "attention should be paid to overall length of questionnaire… [for]…physicians and other medical professionals…" or risk known associated historical difficulty to obtaining high response rates among such busy participants. A shorter version of questionnaire that, all the same, met the intended data collection was designed.

Five pilot questionnaires were mailed to respective potential participants; specifically three questionnaires to Western province involving a healthcare manager, physician and radiographer, and two other questionnaires to Lusaka-based selected participants. Accompanying these pilot questionnaires was a notification declaring the pilot status of the event and, therefore, sought feedback to assist in improving the quality and/or delivery of

the questionnaires. Notably all the pilot questionnaires to Western province were decisively posted to remotest geographical areas covered by the study in first phase. Based on the feedback, the researcher made necessary amendments to the questionnaire and confirmed the planned management of data. Furthermore, it was found prudent to engage pre-paid courier service for expeditious delivery of the questionnaires between the researcher and the participants.

3.4.5 Academic Rigour

The reliability and validity of the questionnaire was considered in terms of triangulating data sources for accuracy of the generated data and an affirmation that the questionnaire actually measured or determined the experts' opinions.

To enhance construct validity, *viz.* extent to which the questionnaire measured the intended themes or concepts, two lecturers in the health sciences department evaluated the questionnaire. The purpose of the second phase *[see Appendix 1]* and findings of the first phase were taken into account in determining the range and perspective of themes to be addressed, leading to the questionnaire's complementary three thematic questions *[see Appendix 7]*. All the participants received the standardized questionnaire, with questions coherently worded in a language suitable to the categories of intended participants. All the participants were known to be accomplished professionals, capable of making and expressing the sought opinions independently. Most of the participants, i.e. managers, physicians and radiographers *[see Table 12 and Table 18],* that completed the second phase questionnaire had actually participated in the first phase interviews where the same themes were embraced, and could be reviewed for priority action at this stage. All the generated data was accounted for, and crosschecked multiple times by the researcher and research assistant, while each returned questionnaire was allotted a serial number and accurately recorded. The data, therefore, reflected the participants' actual submissions based on their expert opinions at that time.

3.4.6 Ethical Considerations

All participants were made aware of the nature of the study through the Information Sheet *[see Appendix 16]* that accompanied the questionnaires, which provided the relevant information including the phase of the study. However, most of the participants in this phase, by their first phase participation, were already familiar with the ongoing study. Confidentiality of participants, adherence to the purpose of the study, and protection of institutional standing, were maintained. The researcher's identity, postal address, email address and phone number were provided within the Information Sheet. The contact address and phone number of the local Biomedical Research Ethics Committee were provided, whilst the approval documents for the study were accessible where required. One organization sought a letter from the researcher with accompanying copies of approval documents for the study, which were delivered prior to sanctioned participation of selected participants from the organisation. The participants were requested to spare about twenty minutes for thoughtful and thorough completion of the questionnaire. The researcher was responsible for all courier delivery of questionnaires between the participants and the researcher, and allowed adequate time of at least one week within which the participant could have found time to complete the questionnaire.

3.5 PHASE 3: TAKING ACTION

The third phase of the study involved implementation of a pilot training programme. The training was conducted at the University Teaching Hospital and Evelyn Hone College in Lusaka, and radiology departments within the Western province. The objectives of the study in this phase were to formulate and implement a training programme based on the most feasible priority intervention identified from the results of the second phase.

3.5.1 The Selection of Participants

The sample of participants consisted of all the radiographers that participated in Phases One and Two (n=17), who were targeted to participate as trainees. The total sample of trainers and assessors of learning outcomes was (n=7) as in Table 9 below. These trainers/assessors included the radiologists selected in Phase Two (n=2), radiography

lecturers with extended role competencies (n=2), a visiting radiologist (n=1), a medical physicist (n=1), and a chief or superintendent radiographer (n=1).

The qualifications and experience of trainers/assessors were considered and deemed appropriate for the intended learning outcomes. These were anchored on scientific principles underpinning diagnostic imaging and reporting process of radiological images *[see Table 10]* among multiple imaging modalities (Eng and Cheah, 2005). The team of trainers and assessors were in active clinical and teaching practice of radiology, medical physics or radiography. This team of practitioners was headed by a consultant radiologist, who hosted the training within the real world environment of a University Teaching Hospital radiology department. Table 9, overleaf, provides a summary of professional qualifications and experience of trainers/assessors:

Table 9: Summary of Trainers' Qualifications and Professional Experience

QUALIFICATIONS	SPECIALISED PROFESSIONAL EXPERIENCE	NUMBER OF TRAINERS
Medical doctors with Masters qualifications and/or fellowship in radiology.	• Practising Consultant Radiologists, part-time lecturers and clinical mentors in radiology at Medical Schools. • Specialised years of experience in radiology: 11 to more than 20 years.	3
Master of Science in Medical Physics.	• Practising Medical Physicist, part-time lecturer and clinical mentor in Medical Physics and Radiation Protection at Medical School. • Years of specialised experience in Medical Physics: 5 years.	1
Bachelor of Science in Diagnostic Radiography; Diploma in Computerised Tomography (CT).	• Practising Diagnostic Radiographer and clinical trainer in radiography. • Years of specialised experience in radiography with Computerised Tomography: 10 years.	1
Bachelor of Science in Radiography; Diploma in Diagnostic Ultrasound; Postgraduate Diploma in Education and Training.	• Lecturer in diagnostic radiography and ultrasound. • Practicing radiographer and ultrasonographer. • Clinical mentor in diagnostic radiography and ultrasound. • Years of specialised experience as lecturer in radiography and ultrasound: 5 years.	1
Master of Science in Professional Studies – Radiography with Advanced Clinical Practice; Postgraduate Diploma in Education and Training.	• Senior Lecturer in diagnostic radiography and ultrasound. • Advanced Practitioner Radiographer practicing in diagnostic ultrasonography and radiography. • Clinical mentor in diagnostic radiography and ultrasound. • Years of specialised experience as lecturer in radiography and ultrasound: 10 years.	1
	TOTAL	7

3.5.1.1 Inclusion Criteria

Local or visiting radiologists in active practice of general diagnostic radiology were eligible to take part as trainers/assessors. The medical physicists with experience in

radiological physics or associated medical imaging science were eligible to take part as trainers/assessors. The radiographers with postgraduate training in extended radiographic role and associated active clinical practice were also eligible to participate as trainers/assessors. Teaching experience among all the potential trainers/assessors was also an inclusion criterion.

The inclusion criteria for the trainees pointed to the radiographers that participated in Phases 1 and 2, for consistent involvement in the process of Action Research; diagnosing of problem, action planning, taking action, and evaluation of action outcome in the fourth phase. The radiographers needed at least 1 year of work experience in radiography practice without any radiologist, to participate as trainees.

3.5.1.2 Exclusion Criteria

Local or visiting radiologists without clinical experience in general diagnostic radiology were excluded from participating in the study as trainers/assessors. The radiographers without postgraduate clinical training in extended radiographic roles were not eligible to participate as trainers/assessors. Lack of teaching experience and/or practising license among all the potential trainers/assessors was also an exclusion criterion.

The radiographers without full practicing license and with less than 1 year of work experience as qualified radiographers were excluded from participating as trainees in this study. The minimum one year work experience meant for the participating trainee radiographers conformed to the eligibility for full practising license of the Health Professions Council of Zambia following one year of successful post-qualification clinical practice. The trainee could be excluded from subsequent blocks of training programme based on performance progression criteria motivated by compelling objective evidence and advice from the trainers' continuous assessment reports. The researcher was not eligible to evaluate the training programme.

3.5.2 Instrumentation and Data Collection

An outline of a training programme was formulated with learning objectives and related content areas through active involvement of the researcher's additional competencies in education and training. The timetables and schemes of work guiding learning activities as well as attendance registers for the trainees and lecturers were developed and applied. Continuous assessment guidelines and progress report forms for both theoretical and practical learning were developed and applied to support adherence to intended learning outcomes. The reference recommended textbooks, either hardcopies or electronic versions, were provided. The use of clinical training environment was approved by the University Teaching Hospital in Lusaka and respective radiology departments where the trainee radiographers could accomplish work-based learning assignments.

A digitizing machine or 10 megapixel digital camera was used for digitizing selected x-ray images (radiographs) during the work-based learning block. The selected digitized radiographs, based on need to confirm interpretation, served as feedback to further learning under the consultant radiologists' film viewing training sessions among other learning activities. The serialised double-paged medical imaging reporting pad version, with retainable carbon copies [see Appendix 17] was used. Furthermore, the learning programme was evaluated by trainers and trainees using a questionnaire shown as Appendix 18, which thematically considered (a) suitability of aim and learning environment), (b) training resources and sustenance, (c) complete implementation and learning process, (d) forecasted outcome, and (e) preferred forecasted skills and programme sustainability.

3.5.2.1 OUTLINE OF THE TRAINING PROGRAMME

The outline of the training programme highlighted the expected learning outcomes, the programme content, the duration of the programme, its mode of delivery, learning and teaching strategies, the assessment methods and the calibre of trainers. The aim of the programme was to facilitate learning amongst participating radiographers in terms of both theoretical knowledge and the skills of radio-diagnostic interpretation and reporting, towards improved radiological service delivery.

3.5.2.1.1 Learning Outcomes

The learning outcomes of the programme reflected the anticipated abilities of trainees after successful completion of the programme, *viz.* (a) to be able to appraise the scientific and technological factors underlying diagnostic radiographic imaging and its radiological interpretation, (b) to be able to evaluate the language of work and the responsibility attached to radiological reporting, (c) to be able to apply evidence-based considerations in the reporting of radiological patterns and the identification of imaging constraints, towards providing conclusive answers to clinical questions, and (d) to be able to uphold their [frontline radiographers'] professional responsibility and work protocols and set priorities towards optimal radiological service delivery.

The Diagnostic Pattern Recognition and Reporting for Radiographers (DP3R) training programme consisted of four units, with each having five content themes. These units were specifically designed around the fundamental prerequisites of developing radiographers' diagnostic reporting capabilities.

According to Kawooya (2008), diagnostic reporting in radiology is effected in a sequence of four steps. The sequence of steps proceeds from image pattern recognition, through analysis of the pattern, interpretation of the analysed result, and culminates in the compilation of a clinical report of diagnostic findings. Table 10, overleaf, summarises the Learning Outcomes and their associated Programme Content.

Table 10: Learning Outcomes and Associated Unit Contents

UNIT TITLE	LEARNING OUTCOME AND ASSOCIATED CONTENT
Science and Technology of Diagnostic Imaging and Reporting.	**Appraise:** • Choice of imaging modalities, preparation and imaging factors. • Equipment performance, maintenance and fault detection. • Basis of differential diagnoses and subsequent/alternative imaging. • Information Communication Technology (ICT) in radiological service. • Teleradiology
Principles and Science of Radiological Patterns and Reporting	**Evaluate:** • Physics of radiological pattern generation and artefacts. • Pattern recognition, description, shape, size, site, texture and variants. • Observation, visualisation, perception and factual pattern evidence. • Decision analysis by Receiver/Relative Operating Characteristic (ROC) curve. • Specificities/sensitivities of lesions and diagnostic opinion/forecasting.
Clinical and Pathological Considerations	**Apply**: • Pathophysiological processes, classifications and relationships in body systems - chest clinical application in this training programme. • Patient condition, history and clinical reference question. • Radiological investigations, Indications and Contraindications. • Holistic patient care in diagnostic investigation process. • Communication with client, clinician and radiologist.
Radiological Service Quality Management and Ethical Considerations	**Uphold:** • Clinical audit. • Reflective practice and Continuing Professional Development (CPD). • Basis of medical ethics and medico-legal considerations. • Radiological work protocols, line of consultation and Standard Operation Procedures. • Evolution of radiological competencies, practice and legislation.

3.5.2.1.2 Mode of Delivery and Duration

The training was delivered in block release, in a total of at least 400 hours over a period of two months. The block-release delivery mode was agreed to by the trainees, the trainees' respective hospital Managements and the trainers so as to ensure that there would be no undue conflict with normal hospital service delivery and/or other existing commitments.

There was a minimum weekly allocation of 50 hours of learning. A total of 200 hours was allocated to residential training in Lusaka, whilst the other 200 hours was allocated to clinically-based directed training in the trainee participant's respective hospital. The training was conducted in four alternating tuition and clinical blocks of 100 hours (two weeks) each, commencing with a tuition block. Tuition for the first two learning units was covered in the first learning block whereas tuition for the latter two units was accomplished in the third learning block. The second and fourth blocks were mainly devoted to student-centred work-based practical or clinical application of learnt theory augmented by learning assignments and extended role radiographer's supervision visits. Under guided learning, the trainees worked on individual assignments on radiological anatomy and pathology, and group case studies on processes of radiological pattern recognition and reporting. The case studies were largely focused on chest radiography. The first phase document analysis *[see Table 13, Chapter 4]* portrayed chest x-ray as the most common x-ray investigation at most radiology departments in the province, including the departments where the participating trainees served as radiographers. This observation guided the starting criterion for clinical training in terms of maximising practical training opportunities and consequent service to the clients. It was also taken into account that the evaluation of training programme outcome was earmarked to take place at the second referral hospital, which also had a record of chest x-ray as the most common x-ray examinations, about 86 percent, in a month covered by document analysis.

The third block included the review of the trainees' clinical learning experiences and assignments in the second block. As indicated above, the learning in the second block focused on the trainees' case studies involving radiographic images, mainly chest x-ray images. The images of particular interest were digitized for review under consultant radiologists' guidance in the third block**.** The capacity to interact with consultant radiologists in respect of the application of factual descriptive image patterns for pathological interpretation in this block allowed for trainees to address their diagnostic challenges. The learning activity also promoted the development of skills relevant to communication and consultancy with radiologists towards intended learning outcomes. Whilst ongoing assessment of learning outcomes was maintained at each block level, the final assessment of attainment of learning outcomes was conducted during the week following the end of the fourth block of the training programme. Attendance registers for

trainees and trainers were maintained throughout the programme. Table 11, below, summarises the undertaken learning activities.

Table 11: Outline of Learning Activities

LEARNING BLOCK	LEARNING ACTIVITIES
BLOCK ONE *[2 weeks x 50 hours=100 hours of learning]* **Residential:** University Teaching Hospital/College, Lusaka.	• Lectures covering Medical Physics, Imaging Equipment, Anatomy, Physiology, Pathology, Imaging Science, ICT. • Skills Laboratory Demonstrations • Students' Clinical-based Learning Assignments/Group Discussions. • Group Tutorials on image viewing, interpretation reporting, case studies, and referral protocols.
BLOCK TWO *[2 weeks x 50 hours=100 hours of learning]* **Hospital-based:** Western Province.	• Handout notes and recommended textbooks for independent study. • Scheduled referenced learning assignments on radiological pathology. • Case studies, image digitizing, and referral communication mentorship by visiting extended role radiographer. • Group learning assignments on image viewing, interpretation and reporting.
BLOCK THREE *[2 weeks x 50 hours=100 hours of learning]* **Residential:** University Teaching Hospital /College, Lusaka.	• Lectures covering clinical conditions, radio-pathological processes, and communication with patients, physicians and radiologists. • Tutorials reviewing Block Two clinical-based learning assignments based on submitted work including digital images. • Class presentations of case studies by students.
BLOCK FOUR *[2 weeks x 50 hours=100 hours of learning]* **Hospital-based:** Western Province Second Referral Hospital.	• Joint and peer reviewed radiological reporting training and ethics at second referral hospital. • Onsite mentorship supervision by extended role radiographer covering diagnostic reporting and communication protocols. • Group tutorials on radiographers' diagnostic reporting and communication protocols. • Assessment of trainee radiographers' reports with reference digital images by radiologists in Lusaka.
FINAL EXAMINATION *[one week]* University Teaching Hospital /College, Lusaka.	• 40% for Continuous Assessments, and • 60% for final examination; written and Objective Structured Clinical Examination (OSCE), and case presentations. • Evaluation of the training programme.

3.5.2.1.3 Learning, Teaching and Assessment Strategies

The training was based on a student-centred learning approach that involved interactive lectures, case studies, problem-based group discussions, clinical mentorship, x-ray film viewing and learning assignments. The references used within the training programme included the prescribed books: Comprehensive Radiographic Pathology (Eisenberg, 2007), Interpreting Chest X-rays – illustrated with 100 Cases (Eng and Cheah, 2005), Applied Pathology for Radiographers (Laudicina, 1989), Evidence-Based Imaging - Optimising Imaging in Patient Care (Medina and Blackmore, 2006), Quality Management in the Imaging Sciences (Papp, 2006) and Principles of Anatomy and Physiology (Tortora and Derrickson, 2006).

The continuous assessment of learning outcomes involved written assignments, written examinations, oral presentations and an objective structured clinical examination (OSCE). The pass mark in all assessments was 50 percent. The trainers carried out the assessments and provided formal verbal and written feedback to the researcher, who was himself a trainer. Additionally, the lead trainer (consultant radiologist) provided formal reports on overall and student-centred learning outcomes that guided progression of the training programme.

3.5.2.2 Programme Evaluation Instrument

The training programme, after the end of the last learning block, culminated in an examination week which included assessment of the programme. This assessment sought to provide an understanding of whether the implemented radiographers' training was appropriate as a remedial intervention towards improvement of radiological service delivery. The trainers and trainees assessed the programme based on thematic areas broken down into several elements, but essentially anchored on the same themes regarding; (a) aim and learning environment, (b) training resources sustenance, (c) complete implementation of learning programme, and (d) forecasted outcome. The fifth option in the questionnaire *[see Appendix 18]* allowed the participants to offer preferred forecasted skills and programme sustainability either as emphasis to earlier responses or other dimension. Using this questionnaire, the participants were able, for example in the first

question, to; determine the suitability of existing link or association between the programme aim with objectives and supportive learning environment (appropriate or inappropriate) for programme viability, and where applicable identify associated challenges to be addressed.

3.5.3 Data Analysis

Data analysis in evaluation of the training programme applied themes with underlying elements, principally assessing adequacy of the training programme with respect to learning outcomes, supportive learning process, and forecasted sustainability of the programme. Apart from the first part of the questionnaire, which required precise response and quantitative analysis by rate of scores, the rest of the responses were open-ended and qualitatively analysed. The data from all the twelve completed questionnaires were word processed, synonymous with Appendix 8, for close analysis of responses in determining thematic bearing, based on questionnaire design illustrated above under Programme Evaluation Instrument. For this reason, representative quotations were used in representing the results that correspondingly addressed the same theme. Where diverse views were observed under the same theme, such views would be reflected in their respective perspectives. In this way all the data were presented or represented.

3.5.4 Pilot Study

The researcher, research assistant, and one senior lecturer at the local school of radiography independently studied the draft questionnaire to ascertain clarity of questions, and assessed the post-piloting responses to ascertain consistency and/or other observations. The provision of several responses for each question was acknowledged for augmenting possible varying emphasis, for the same theme, among the participants' responses. The questionnaire was piloted after a one week's in-service medical imaging training in Lusaka, involving two of the lecturers that participated in the DP3R training and two radiographers comparable to those for DP3R training programme. One Learning Unit of the DP3R programme was piloted in the in-service training programme and culminated into piloting the evaluation questionnaire. The piloting status of the learning unit and questionnaire were clearly indicated to the four participants to elicit appropriate feedback.

The language used in the questionnaire *[see Appendix 18]* was found appropriate for the level of participants, who would be familiar with such evaluation terminologies through participation in evaluating technical activities including mentoring of students attached to clinical sites as part of their usual practice. Necessary post-piloting amendments were made to the questionnaire, and considerations pertaining to the administration of the training programme were also accordingly addressed based on related feedback. The considerations included need for trainees' lodging facilities to be convenient for independent study after scheduled learning periods. At this stage, ways of managing, processing, and analysing the data were planned in line with the themes that the questionnaire addressed.

3.5.5 Reliability and Validity

The training programme was aligned to the remedial training plan as determined in the second phase of the study. The programme title, Diagnostic Pattern Recognition and Reporting for Radiographers (DP3R) encompasses diagnostic interpretational processes and subsequent diagnostic reporting for radiographers. The programme content took into account the prevailing education, skills, and competencies among the radiographers to suitably match the entry pre-requisite to DP3R. The validating process of the designed programme adopted formal criteria of designing a learning programme led by the researcher, who was suitably qualified in the processes of education and training involving radiography and other health sciences programmes. All the participating lecturers or trainers were appropriately qualified and licensed in their respective roles *[see Table 9]* and all the trainees were licensed practising radiographers. The proposed training programme was also approved by the Department of Radiography at Durban University of Technology.

A formal education and learning process was followed using authentic materials and processes, including textbooks (hardcopies and electronic), radiology machines in established Government institutions, diagnostic reporting pads comparable to existing reporting format, and formal continuous assessment of learning outcomes using multiple assessment methods. The programme evaluation questionnaire was piloted before being

used to evaluate the programme and covered relevant themes for evaluating a learning programme: (a) aim and learning environment, (b) training resources sustenance, (c) complete implementation of learning programme, (d) forecasted outcome. The lecturers and trainees as participants in the evaluation process of the training programme, were by professional standing, able to form independent opinions. Most of the participant trainers (radiologists and radiography lecturers) and trainees (radiographers) that completed the third phase questionnaire had participated in the preceding second phase of the study.

3.5.6 Ethical Considerations

In the interest of reducing errors and maximizing accuracy to enhance safety, with the radiologists acting as reviewers, trial reporting was used as part of the learning process during the second, third, and fourth blocks of learning. Furthermore, double reporting was used with at least two radiographers required to assess and affirm the diagnostic report. All the radiographers were fully registered with the Health Professions Council of Zambia. The reporting radiographers entered their names, signatures, and departmental phone numbers on all their written reports. These processes served to ensure patients' safety from erroneous reports and/or irresponsible interpretations and communication of diagnostic findings. In case of courier-delivered digital images for consultancy and learning purpose, the images would be coded as the patients' names remain withheld from the digital images on account of confidentiality.

The low turnout of radiographers for the training programme and the voluntary participation provision cited in the Information Sheet *[Appendix 14]* were considered. Going by the first phase results, the challenges faced by radiographers who worked alone, without back-up during absence from their departments to undertake training, were particularly apparent. The question of whether it would be permissible for all the radiographers to simultaneously leave their stations for training was reflected upon. The researcher complied with the hospital managements' discretion for approving the radiographers' participation in the ethical interest of maintaining the healthcare services uninterrupted. Du Plessis, Friedrich-Nel and van Tonder (2012) have reported such challenges in their study involving opportunities for postgraduate qualifications among

radiographers. Nevertheless, the number of trainee participants realised enabled the implementation of the designed learning process.

3.6 PHASE 4: EVALUATION OF ACTION

The fourth phase of the study was aimed at evaluating the effectiveness of the intervention implemented in the third phase of the study. Through this evaluation it would be determined whether the action effectively represented a workable remedial intervention responsive to identified problems and views presented in the first phase and second phase. The effectiveness of the radiographers' programme was evaluated in terms of satisfaction with the radiological services among the clients when an additional dimension of radiological services, i.e., diagnostic reporting, was added. The evaluation took place at the second referral, and busiest, hospital within the Western province.

3.6.1 The Selection of Participants

The evaluation took place within the normal hospital work-environment of the second referral hospital in Western province. The cited hospital had the busiest radiology department with referrals from other hospitals in the province. All the radiographers (n=6) that successfully completed the piloted radiographers' training programme as trainees in Phase Three were invited to take part in this fourth phase. All the patients that were served with the radiographers' chest x-ray diagnostic reports (n=86) during a period of two months were invited to take part in evaluating the quality of radiological services with the reports. All the selected patients had prior experience of receiving x-ray radiological service. All the physicians (n=14) available at the second referral hospital at the time of the study were invited to participate in evaluating the outcome of the radiological services with radiographers' x-ray diagnostic reports.

3.6.1.1 Inclusion Criteria

Only those physicians who had participated in the first and second phases of the study were eligible to participate in the fourth phase of the study. All the physician participants worked in Western province. Meanwhile, all the radiographers who successfully

underwent training in Phase Three were eligible to participate in offering the diagnostic reports in this fourth phase. The inclusion criteria among participating patients involved prior experience with radiological services.

3.6.1.2 Exclusion Criteria

Visiting or trainee physicians were excluded from participation. The radiographers who might have, for any reason, discontinued the training in Phase Three were also excluded from participating in this fourth phase. The patients without prior experience of receiving radiological services were excluded from participating as their capacity to genuinely assess the quality of the received radiological service would be deemed uninformed. Furthermore, the patients seeking other radiological services different from chest x-ray/radiography were excluded from the study. This criterion was on account of practical training focus in the available training time where chest x-ray examinations were the most common x-ray investigations essentially at radiology departments where the trainees served, ranging from 68 percent to 90 percent *[see Table 13]*, which included the second referral hospital hosting this fourth phase of the study.

3.6.2 Instrumentation and Data Collection

The evaluation of action was not intended, merely, to be a direct comparative evaluation with reference to changes in levels of client satisfaction against the diagnostic first phase. The evaluation focused on the clinical impact or outcome of the training programme *[see Appendix 20]* based on interpretation of the clients' satisfaction with the provided service. This evaluation, in which both physicians and patients were participants, was conducted soon after patients accessed clinical services and received diagnostic chest x-ray reports at the only highest (second referral) hospital located in Mongu, the provincial headquarters *[see Appendix 2 and Appendix 3]*.

One closed-ended item, of the 5-item Likert scale type, was included in the questionnaire for purposes of garnering information on clients' levels of satisfaction with the post-training radiological service outcome. In particular, clients were requested to indicate, in this manner, their levels of satisfaction with the diagnostic reports that accompanied chest

x-ray images. With regard to client service and satisfaction with radiological services, Philip (2000: 322) recommends "…both patient and referring physician satisfaction should be monitored periodically…" for possible changes in clients' opinions on quality of radiological services expected and received. Philip (2000) records useful experience with the cited version of "…5-point best-to-worst…" rating scale, which works well when "…additional space is allowed for comments". Questions 4 and 5 in the questionnaire, essentially, augmented the cited closed-ended item. Meanwhile, item 6 provided more opportunity to extend responses to question 2 of the questionnaire. Being an extension of question 2, it would be possible that adequate participation in question 2 would render question 6 scarcely or not completed, as complementary to the existing data in the former.

The questionnaires, with enclosed self addressed envelopes, were delivered to physicians through existing delivery channels for express correspondence within the hospital. Each physician received one questionnaire by the end of the two months period of receiving multiple radiological reports. With regard to patients, the questionnaire was administered by means of face-to-face interviews carried out by the research assistant after the patient had been attended to by a physician. The research assistant's proficiency in the local languages, as an added advantage, facilitated completion of patients' questionnaires.

3.6.3 Data Analysis

The questionnaires were grouped into physician and patient categories and serialised accordingly once completed. The respective exact data from each category were all transferred into computerised/word processed datasheets to facilitate convenient search of thematic clues and further analyses. The data from question 3 with the 5-item Likert scale was subjected to Microsoft Excel, spreadsheet software, to aid in analysis of scores of categorised levels of satisfaction and associated frequencies of percentages.

3.6.4 Pilot Study

The designed questionnaire in this phase was aligned to first phase interviews, guided by the theoretical framework whilst some aspects of accessed comparable questionnaires, such as brevity, were also considered. Prior to piloting among two physicians and two

patients from the sample frame, critical review of the questionnaire was independently done to reach a consensus among the research assistant, one chief radiographer outside the sample frame, and the researcher. The responses from the piloted questionnaires were analysed by a panel of academic experts in research to assess pattern of consistency in the responses. The management of the data was, accordingly, planned in terms of serialising, categorising, tabulation, word processing and software applications.

Ways of administering the questionnaires among the participants were recommended, which entailed self-completion among physician participants. Face-to-face interviews were recommended for patient participants as some patients would be unable to complete the questionnaires for varied reasons, including illiteracy. A face-to-face interview, where an interviewer (the research assistant in this case) asks questions in the presence of the respondent and appropriately completes the questionnaire (Robson, 2011), was devised as an alternative way of administering questionnaires. The research assistant was conversant with conducting such interviews through mentorship from the researcher and his university degree in developmental studies.

3.6.5 Academic Rigour

The design of the questionnaire was guided by applicable concepts in the theoretical framework guiding the study, as these relate to the Service Result level. A panel of academic experts during the pilot phase validated the data collection instrument *[Appendix 20]* to ensure that it measured what it was supposed to measure. Furthermore, two categories of data sources, physicians and patients, as clients of the radiological services, were used to triangulate the data.

3.6.6 Ethical Considerations

The ethical considerations entailed not to harm or cause harm to the participants, or participating institutions, as a result of their participation in the research (Colquhoun and Kellehear, 1993; Oppenheim, 1999) bearing in mind harm could arise in the form of physical harm, emotional injury or distress, or injury to the respective institutional reputation. All the participants had information regarding this fourth phase as a

continuation of the preceding three phases *[see Appendix 14 and Appendix 16]* and they willingly agreed to take part in the study. The researcher's commitment to foreseeable dissemination of the findings, accessible through participating institutions and internet, was taken into account.

All the patients that took part in the evaluation phase sought hospital services on their own accord and had physicians' requests for chest x-ray examinations not influenced by this study. The confidentiality of the participants was maintained, as only their categories such as 'physician' or 'patient' were documented. No specific physical address, other than general area name, of the participants was required in the questionnaire. The question of focusing on chest x-ray reports was explained to the patients to allay possible anxious presumption that some patients could have been denied the service.

In order to uphold accuracy of the radiological reports, at least two radiographers were required to jointly agree and endorse the diagnostic report as an ethical responsibility that maximises safety to patients. Following imaging, the radiographers spent about 30 minutes, on average, to interpret the patient's radiograph/s and prepare a hand written diagnostic report. Meanwhile, consultation access with the consultant radiologists in Lusaka was maintained among the radiographers through available Information Communication Technology, including communication by phone. Secure courier delivery of digitised images was considered, in the absence of dedicated teleradiology facilities, where the consultant radiologist needed to view the image/s for expert guidance or confirmation.

CHAPTER 4

RESULTS

This Chapter presents the research results in the Action Research cyclical sequence in which they occurred. The results are derived from the four phases of Figure 1; diagnosing, action planning, taking action, and evaluating outcome of action based on research objectives. Each of the four phases highlights sample realization and addresses the results under the guidance of the Human Capital Development theoretical framework.

The cyclical order of Action Research phases design and the theoretical framework were maintained. The theoretical framework, guiding the study, consists of the four levels *[see Table 6]* derived from the Accenture Human Capital Development Framework (Thomas, Cheese and Benton, 2003). The substantive concepts of the theoretical framework were used as broad categories for data analysis and interpretation of results. These levels include Human Capital Processes, Human Capital Capabilities, Performance Drivers and Service Result.

4.1 PHASE ONE

This phase was concerned with the diagnosis of problems arising from the coexisting absence of radiologists and the absence of extended radiographic skills (amongst existing radiographers). The objectives were to (a) analyse the existing radiographic services and/or practices in rural Zambian healthcare facilities without the radiologists, and (b) to examine the views of the practitioners and patients on the status of the radiological service provision in the cited context. This first phase was pursued through interviews with healthcare practitioners, patient satisfaction interviews, and analysis of relevant documents *[see Phase 1, Chapter3]*.

4.1.1 Sample Realisation

The sample realisation for interviews among healthcare practitioners is shown in Table 12 as an indication of the rate of participation within one geographical and administrative region of Zambia, the Western Province.

Twenty-nine *[83 percent]* of the 35 physicians and 17 *[89 percent]* of the 19 radiographers working at various hospitals in the province, participated in the first phase of the study. All the available healthcare managers (n=8) agreed to participate in the study. In exceptional cases, clinical officers and radiography assistants, as practitioners below the level of physicians and radiographers, respectively, were interviewed once they had been found to be the only key practitioners willing to participate in the study in some radiology departments. The total number of healthcare practitioners who participated in the first phase of the study was 61. The tabulation of sampling by district appears in Table 12, below:

Table 12: Interview Participation Rates involving Healthcare Practitioners

District	Healthcare Managers	Physicians	Clinical Officers	Radiographers	Radiography Assistants	Totals
Kalabo	1	5	1	2	0	9
Kaoma	1	3	1	3	1	9
Lukulu	1	2	1	1	0	5
Mongu	2	13	0	6	0	21
Sesheke	1	3	1	3	1	9
Senanga	1	3	1	2	0	7
Shangombo	1	0	0	0	0	1
Total	8	29	5	17	2	**61**
% of Total	*13.1%*	*47.5%*	*8.2%*	*27.9%*	*3.3%*	*100%*

A total of 170 *[82 percent]* of the 208 targeted patients participated. Among these 170 participants, five *[2.9 percent]* were by patients' representatives or proxies (Dawson, 2009), as in cases of parents representing babies/children requiring radiological services. In this regard, the challenges associated with quality of radiological services could ably be represented by close family members.

With respect to document analysis, the researcher was able to analyse the 2010 radiology registers of eleven hospitals *[see Appendix 19]* which included five Mission hospitals, five district hospitals, and one general hospital. Furthermore the hospital referral registers for

2010 in all six districts were accessed. Other documents accessed were: (1) the 2009 *Western Province Technical Support Report on Radiology*, (2) the 2009 *Western Province Consolidated Performance Assessment*, (3) the *Zambia's Sixth National Development Plan 2011-2015* summary document, (4) the Ministry of Health's document on *Human Resources for Health Strategic Plan 2011-2015; Increasing the Number of Trained Health Workers Available to the Sector*, (5) *the National Health Services Act No. 17 of 2005, (6)* the *Health Professions Act 24 of 2009*, of the Laws of Zambia (Republic of Zambia: 349-393), (7) *the ORET Project Report on Upgrading of Radiological Services*, and (8) map of Western Province Healthcare Facilities.

4.1.2 Service Result

Under normal circumstances, Service Result measures the ultimate goal of the organisation and/or department. However, within the context of this study, Service Result was measured against the Country's vision and mission for the delivery of healthcare services in Zambia. In this regard, the Ministry of Health vision "to provide Zambians with equity of access to cost-effective quality health care as close to the family as possible" - National Health Strategic Plan, (Ministry of Health, 2005) was the reference criterion. The Sixth National Development Plan upholds the same vision; "equitable access to quality health care by all by 2030" with the goal set "to improve the health status of people in Zambia in order to contribute to socio-economic development" (Ministry of Finance and National Planning, 2011). Hence accessibility and cost of radiological services to patients and healthcare facilities were the major themes that emerged from data analysis under Service Result.

4.1.2.1 *Accessibility of Radiological Services*

Chest x-ray was found to be the most commonly carried out x-ray investigation in most hospitals in the province, ranging from 68 percent to 90 percent, as shown from document analysis depicted in Table 13 overleaf:

Table 13: Most Common X-Ray Examinations in a Month Preceding the Study

HOSPITAL S (numbered 1 to 11)	TYPE OF MOST COMMON X-RAY EXAMINATION	RATE OF MOST COMMON EXAMINATIONS	NUMBER OF ALL EXAMINATIONS IN A MONTH
1	Chest	280 *(77.7 %)*	360
2	Chest	220 *(83.9 %)*	262
3	Chest	1200 *(85.7 %)*	1400
4	Abdomen	90 *(75.0 %)*	120
5	Chest	120 (71.4 %)	168
6	Abdomen	70 (58.3 %)	120
7	Skeletal	80 *(66.7 %)*	120
8	Chest	167 *(69.3 %)*	241
9	Chest	92 (90.2 %)	102
10	Chest	167 *(68.2 %)*	245
11	Chest	89 (89.0 %)	100
TOTAL			**3238**

The most common x-ray examination was also indicated among the practitioners. The excerpts below affirm this position:

> *"With our population basically the common radiological investigations that we request are x-ray and ultrasound...but the most common one is the chest x-ray…."* ***[Physician]***

> *"In terms of radiological investigations, x-ray is more common in general terms but most x-rays are chest x-rays because we have a number of patients with chest problems for x-rays of the lungs and other chest problems…."* ***[Radiographer]***

> *...but for now I am working in the children's ward; may vary with children…. This time of the year the cases you find on the ward are chest conditions…making chest x-rays leading, but there are other conditions too.* ***[Physician]***

Widespread referrals were indicated as frequently causing anxiety amongst patients and their relatives. Such referrals were also linked to delays in diagnosis and treatment, or discontinued healthcare. In some cases, the concerns pertaining to referrals were seen as compounded by poor intra-provincial transport terrain, whether this is road or waterway. The routes between the General Hospital in Mongu and some districts (Kalabo, Lukulu,

Shangombo and Sesheke) were found to be hardly accessible or inaccessible during the wet seasons of the year. The excerpts below highlight the challenges of accessing the required radiological services:

> *"...the other thing is delays in making the diagnoses from x-rays...also, we tend to have patients who come with threatened abortion; usually we want to do ultrasound scan to determine foetal viability. Sometimes we want to assess complete or incomplete abortion by ultrasound scan ...before one can get a clear judgement. You find that the time for making the diagnosis or treatment for the patient is delayed because the patient has to go somewhere else and then come back."* ***[Physician]***

> *"...Sometimes with other patients they* [Management] *would say, 'no, this case does not require emergency attention; we can wait'...sometimes they* [patients] *feel they are neglected* [in such situations]. *Sometimes the patients and relatives come back from the villages to say they cannot manage on their own - so with those it's like they are not attended to."* ***[Radiographer]***

> *"Then we are not doing justice to the patient because the condition of that patient might be worsening just because we have not done an examination that has to be done.... Some of them self-refer themselves to Lusaka, if they have the money..."* ***[Radiographer]***

> *"...in fact even some of these investigations, as for echocardiography, we have to refer the patients; which is not good, considering how inaccessible we are."* ***[Physician]***

> *"Ok, according to my experience... I have discovered...waste of the patients' time and ... logistics in radiology when the diagnosis is delayed or imprecise without reports."* ***[Clinical Officer]***

> *"The consequences are unbearable. At times this can result into the patient maybe losing the life because of the delays and referrals of the patient from one hospital to*

another then the condition of the patient goes worse just because we didn't help that patient at the initial period..." ***[Radiographer]***

The recognised role of the radiological services in the early detection of diseases and its influence on life expectancy were commonly cited by the participants. The excerpts below highlight concerns associated with radiological based early detection or diagnosis of diseases:

"We don't have Barium Meal or Barium Swallow [examinations] *so it is not easy for us to diagnose peptic ulcer disease...if it is there or not there; so we just diagnose clinically."* ***[Clinical Officer]***

"[The consequences with limited radiological services result into] *misdiagnoses of pathologies, which leads to misplaced treatment and healing."* ***[Patient]***

An overview of hospital referral records revealed that the referrals were either from one first-level hospital to: another first-level hospital; a general hospital within the province; a general hospital outside the province; or the University Teaching Hospital in Lusaka – about 600 km from Mongu, the provincial capital of Western province. The recorded reasons for radiology-related referrals included undetermined chest conditions, skeletal trauma, undetermined abdominal conditions, cardiac diseases, and a miscellany of indications requiring specialised radiological investigations *[see Appendix 19]*. The patients came from widely-dispersed locations, and sometimes through their respective rural health centres, e.g. a patient from Kalongola, a rural area in Shangombo district, was referred through the local health centre to Senanga District Hospital, then to Lewanika General Hospital, and eventually to the University Teaching Hospital in Lusaka.

The *Consolidated Performance Assessment for Western Province* document (Ministry of Health, 2009a) confirms that there is typically no effective communication between the referring and receiving hospitals on the referred patient, and, in this study, referral feedback data between hospitals was found to be either difficult to attain or absent.

According to the National Health Services Act 17 of 2005, policy formulation and implementation plans, all healthcare services were centralized under Ministry of Health with headquarters in Lusaka (Republic of Zambia, 2005: 107-114). The records involving radiology/hospital registers, reports, and map of Western province healthcare facilities [*see Appendix 19 and Appendix 3]* highlighted several challenges associated with radiology-related referrals at various levels of healthcare. The challenges attributed to patients and healthcare facilities pointed to distressed expenditure, distant journeys, inconsistent mode of transport on varying terrains, and lengthy time involved in attempts to achieve relevant radiological services. Referrals, *per se*, could be a standard practice in a normal healthcare setting. However, there was need to discern possible service gaps *[see Appendix 19]* linked to the criteria for existing referral picture through data analysis and participant interviews. Some of the reasons for referrals were associated with lack of radiological reports as observed by some practitioners in the excerpts below:

> *"X-ray reporting will be much helpful; for some of the x-ray examinations for interpretation or specialised x-rays…..we have to refer patients ..."* ***[Physician]***

> *"I believe we need to have someone to interpret x-ray images to give us report on the diagnosis… when I was a medical student we had the radiologist in the [radiology] department who used to provide radiological reports…and reports were brought to the physicians without referring patients."* ***[Physician]***

> *"If radiological reporting was introduced for radiographers, even at diploma level, I think that would be really helpful...especially in rural areas where referrals are difficult. You find that we don't have radiologists…The remedy I think comes back to reporting."* ***[Radiographer]***

4.1.2.2 *Cost to Patients*

Among the repeatedly presented concerns, was the elevated cost to patients associated with their need to seek services elsewhere, when those services were not available locally. The excerpts below highlight these concerns:

"...but those that do not have money for the referral, come back [to seek help] *because they are unable to bear the travel cost* [of travelling to Lusaka]*."* ***[Radiographer]***

"It is quite costly because we have to make the patients move on daily basis, sometimes to have an investigation done some people have to travel to Mongu (Lewanika General Hospital) - because under our criteria for referral, mostly these are non-critical patients [for the hospital to take up the cost]. *It is...expensive on their part to have that investigation for us to make a decision on how we are going to treat...."* ***[Manager]***

"Anyway...once in a while we get a complaint when referring someone. Since when it is non-emergency they have to use their means of transport. That's when you see people getting annoyed and they complain as to why we can't provide such services." ***[Physician]***

"...People are poor here and we ask them to go to Mongu or Lusaka…you find that they can't meet the travel cost..." ***[Physician]***

The costs of some examinations, such as computerised tomography (CT) which involves patients needing to travel from their district to Lusaka, were considered by patients to be unaffordable. Some patients therefore failed to honour their referrals to distant hospitals, in addition to the further challenges of long waiting lists and the associated cost of needing to wait for the appointment in Lusaka.

"The patients get stuck! They don't have money even to go to Mongu. In fact we have the patient whom I want to go for a CT scan [in Lusaka] *but it's so expensive..."* ***[Physician]***

"...patients' referrals to other institutions require money; for some [patients] *it is difficult to go* [for referral]*...they just die at home."* ***[Patient]***

"Improve the services….patients should not be travelling to big hospitals for other [radiological] *services."* ***[Patient]***

"[We need]*...cure and treatment fast* [and with] *no referral to* [named] *hospital."* ***[Patient]***

4.1.2.3 *Cost to Health Facilities*

There were notable cost concerns linked to the use of healthcare facilities when such use was associated with frequent, and avoidable, referrals. It was observed that non-conclusive or specialised radiological investigations were among the leading causes of referral within the healthcare provision *[see Appendix 19]*. In some cases, the hospitals were responsible for the transportation of patients, and, depending on the severity of the patients' condition, that of accompanying relatives and healthcare personnel. The excerpts below highlight related participants' views:

"...usually the patients lack transport so there is more money needed [from the hospital] *to go to other places for the same radiological service that is not here…"* ***[Physician]***

"The consequences of the referrals; to start with, certain referrals are very costly like here you consider the distance [200 kilometres] *from here to Livingstone... So sometimes you find that there is only one patient; they have to dispatch a vehicle... like today it happens and tomorrow you have another case; because such cases you can't say no we wait for another one. On the other hand the Management tends to spend a lot of money as well as the patients' time."* ***[Radiographer]***

"...we sometimes take the responsibility when we are referring to a higher level hospital. ...we at least provide transport for the patient and only one relative...so we are responsible for putting it [activity] *in the budget per month...for...such arrangements."* ***[Physician]***

Erratic supply of electricity was also cited as concern of the management personnel of some hospitals, in which it was identified that some referrals and/or delays in radiological investigations were related to erratic availability or use of electrical radiological machinery. Such referrals were known to be mainly directed to hospitals at the same level of service provision (lateral referrals). It was noted that even when hospital management provided transport for such referrals, the patients were not pleased to be transferred to other hospitals. The perception was exacerbated by the fact that such referrals often involved a larger number of patients, and therefore created unplanned congestion at the receiving radiology department. The excerpts from the participants' views pertaining to such referrals are presented below:

> ***"****The other challenge is of [named] Mission hospital where there is no constant electric power supply. So, x-ray services are only available partly during the day for only 4 hours period after that those who need radiological services have to wait or be referred to [named] district hospital."* ***[Manager]***

> *"...the other challenge is on connection of the hydropower electric-generator to support modern radiography machines, because the machine we are using is very old and analogue."* ***[Radiographer]***

> *"Patients should not be sent to* [named district hospital] *to reduce cost."* ***[Patient]***

4.1.3 Key Performance Drivers

The Key Performance Drivers are seen as the environment and those mechanisms aimed at steering the outcome of service delivery. At the level of performance drivers, the intermediate organisational or departmental outcome or quality of the service is determined through: (a) the quality of service delivery, (b) innovation and productivity, and (c) client satisfaction.

4.1.3.1 *Quality of Service*

The lack of appropriate equipment, inadequately trained radiography personnel and rigid scope of practice boundaries were cited as the most common factors affecting productivity and/or the quality of radiological services in rural western province of Zambia.

The practitioners expressed various views regarding the status and implications of the radiological services with respect to their conformity with standard professional practice. These concerns focussed on deficiencies in the radiological services, encompassing radiological reports, contrast media-aided investigations, diagnostic ultrasound with echocardiography, computerised tomography (CT), fluoroscopy and digital radiography. The excerpts below illustrate the concerns expressed on the quality of the available service:

> *"In fact we have to refer* [patients] *because I think, like what I said for other investigations, it is a challenge....So we would help if we were doing things like HSG [hysterosalpingography], IVU [intravenous urography] and echocardiography all with reports..."* ***[Physician]***

> *"... right now we have a patient for CT scan... it's useless without report...we have a challenge when it comes to reading of the x-rays, like in the country we have very few radiologists; they go to school for a number of years to read x-rays..."* ***[Physician]***

> *"According to the number of patients and conditions, a fluoroscopy machine would be better. If it were there, we would do other bigger investigations. I think even barium meals with fluoroscopy…would still be a problem because the radiographs won't really be interpreted the right way without qualified interpretation. You would find a patient has been attended to and still takes time for that patient to be treated correctly, so I think it all comes to the issue of not having a radiologist because really these special investigations e.g. urethrogram or barium meals could be concluded here without referring patients….but, like in ultrasound, they [special investigations] need presence of a person to interpret whole procedure up to hardcopies…"* ***[Radiographer]***

"Without radiological report you are sometimes required to repeat the x-ray when the radiograph is seen as of bad quality, yet it is the nature of chest condition…and compelled to refer the patient, which becomes costly and more use of radiation and radiology resources...you also take more time on one patient." ***[Radiographer]***

There seemed to be an understanding that the quality of radiological services was to a large extent determined by the quality of radiological infrastructure and available equipment, as in the excerpts below:

"... on the maintenance of the machines; I don't know whether you teach them [radiography personnel] *how to care for the machines because they should be able to tell whether the machine is working properly... we notice there're artefacts on x-ray films and we have to get back* [to radiology department] *... And the other thing is a system for them to acquire some requirements for the department..."* ***[Physician]***

"Last time I was talking to the medical officer if he can manage to buy this equipment so that we can start doing the special investigations but I have been told that we are not allowed to do these special investigation without radiologist ...the patients are...transferred to other hospitals,...[for specialised radiological investigations]*"* ***[Radiographer]***

"We don't have Barium [radiological examinations]*...so it is not easy for us to...just diagnose clinically. So you find that sometimes we make mistakes - but you can just say maybe... this could confirm - but we don't have barium meal examinations."* ***[Physician]***

4.1.3.2 *Innovation and Productivity*

The practitioners (physicians, clinical officers and radiographers) held comparable views with respect to team involvement and cost-effectiveness within the projected conducive healthcare services delivery to the community. Various parameters of improvement of the

quality of the service provision (Brown *et al.*, 1990) are considered in determining those priorities which healthcare managers should promote, through appropriate investment in remedial action, based on suitably sourced information. In this study, both the providers of the service (practitioners) and the recipients of the service (patients) were involved in the identification of areas for prioritised improvement, as shown in the excerpts below:

> *"Ok, yes I think at Level One Hospital, which are district hospitals; I would want imparting of skills in the people that are working as clinicians* [physicians and clinical officers] *especially that we as clinical medical officers in our training, we only do little radiology- there was no chance of shooting* [exposing] *x-rays. I wouldn't mind if I am oriented to do an x-ray because for scans somehow we picked up the skills - you know - as we rotate through these big hospitals. Shooting an x-ray; if that can be extended even to us clinicians to appreciate use of radiology ... I am looking at the level of the hospital where I work. ...I would not mind being trained."* ***[Physician]***
>
> *"...so I was thinking that at a time when a certain training is offered pertaining to x-ray...you could also orient some physicians and clinical officers so that they are updated on radiological investigations or some sort of guidelines on procedures...I think that will be good."* ***[Clinical Officer]***
>
> *"...we also have in most cases rather old machines, without Colour Doppler in ultrasound for example - only black and white...that is also a negative factor in the quality of our work."* ***[Manager]***
>
> *"...even the PNS* [paranasal sinuses] *examination for the head are not even requested like small bones, the sella turcica and temporal bones. So each time you just find 'Skull x-ray.' ... so we just ...presume what they mean. And the other thing, we have a theatre C-arm, which we rarely use...the equipment is there that is supposed to guide* [operating theatre] *procedures.... Therefore, theatre radiography it is not even done."* ***[Radiographer]***

The patients' suggestions towards the necessary improvements to uplift the radiological services, obtained through the interviews, reflected shortcomings and below-optimum service output in the radiological service delivery in the public domain. Table 14, below, shows a summary of the patients' suggestions towards improving the radiological services, backed by additional views beneath Table 14 suggesting patients' perspectives of what constituted improved radiological services. For example, increased radiological workforce could have been linked to improved rate of issuing radiological results and explaining results, seemingly implying the status quo enabled the radiographers to explain the results to patients or clinicians.

Table 14: Patients' Suggestions towards Improving Radiological Services

PHASE ONE PATIENTS' SUGGESTIONS	PREFERENCE RATES
Increase radiology workforce and skills	62 *(36.5%)*
Introduce new and advanced radiology machines	60 *(35.3%)*
Introduce more radiological examinations	48 *(28.2%)*
TOTAL	**170** *(100%)*

The patients' perspectives of what constituted improved radiological services are highlighted in the excerpts below:

> *"The department* [needs] *to improve by giving the patients their results...there should be staff - the radiographer - in the department to explain the findings."* ***[Patient]***

> *"The department should provide the x-ray reports. ...Increase number of qualified personnel* [in radiology department]" ***[Patient]***

> *"Buy new x-ray - good and modern - machines for the community. ...We should have more than one radiology machine."* ***[Patient]***

> *"*[The department] *needs the use of advanced* [radiology] *equipment so that patients do not wait for a long time."* ***[Patient]***

"Echo [echocardiography] *will help early diagnosis of heart problems...provide them* [radiology personnel] *with advanced machinery and many staff."* ***[Patient]***

"Expand the radiology departments so that many patients can be examined at once. ...and accommodate other radiological services." ***[Patient]***

Some patients appeared knowledgeable of apparent technical information depending on educational background and orientation of interests or inquisitiveness as may be the case when clinicians make certain recommendations. This observation may be associated with the excerpt below:

"There should be Barium meal examinations ...to examine ulcers ... [and] *HSG* [hysterosalpingography] *examinations."* ***[Patient]***

In reference to those hospitals that operated without any radiographer, the participants emphasised the importance of striving towards the availability of full-time radiographers within the hospitals. The physicians saw the radiographers as an important element of the healthcare team, and identified their role as serving, *inter alia*, as technical catalysts of innovations within the radiological services. It appeared that the radiographers themselves were also driven to see the necessary infrastructure, including suitable machines, as the patients emphasised on efficient and uninterrupted service. The excerpts below support these assertions:

"I think we can give some proposal...; if we can have a trained staff [radiographer] *with good planning, we can manage - as long as we know the importance of the radiological investigations. In fact I was talking about the shortage of products* [contrast media] - *it's now more than three years...the proposal that I can give is; good planning...so that we cover all our needs."* ***[Physician]***

"...What I want to see first of all is a control on quality of the imaging system to be changed to digital; ...radiographers to improve quality of imaging because when

the image is poor even the investigation or procedures will be [negatively] *affected."* ***[Radiographer]***

"...with x-rays, I think the equipment we have is sufficient enough to assist and I think it would even do for specialised examinations like if you consider things like special procedures like Barium examination or the IVU...but you see what is lacking on the ground is the so called skilled personnel that is radiologist or even advanced radiographer....some hospitals were left out of the ORET project that supplied these digital x-ray machines and laboratory equipment countrywide...They [hospitals] did not have radiographers to use the machines...and you know skills is not overnight matter." ***[Radiographer]***

"Apart from bringing in new equipment, specific skills are important ... we have to think about the human resource; qualified staff who may be able to operate such equipment with the skills to offer tangible services..." ***[Physician]***

"...increase the numbers of staff working in the department, so that patients don't wait for a long period to receive the service. ...and ensure the department is always operating..." ***[Patient]***

"...procure enough x-ray films so that patients don't wait for a long time to be examined." ***[Patient]***

A comparison between the Government hospitals and Mission hospitals revealed the latter to have peculiarly more pronounced inadequacies, in terms of radiological machinery. The excerpts below highlight the nature of findings:

"...we have only a portable x-ray and we missed the project that was there under the ORET [project]*...Initially we were on the list, but they said that they 'wanted people who could utilise the equipment to the full' and at that time we only had a radiography assistant* - [informally trained personnel]*; we didn't have a radiographer, so they were reluctant* [to give us the new machine] *until the project came to an end."* ***[Manager]***

"...as first radiographer [at hospital initially without radiographer] *you find that there is a small machine and when you look around there is no* [imaging] *darkroom, no processing tank, no everything that you need..."* ***[Radiographer]***

"...we did not benefit from the [ORET] project, we have a very old x-ray machine maybe even dangerous and out of service [obsolete]; *so, we want these people from Lusaka... to visit* [us] *and see the state* [of the machine] *... they should calibrate the machine - because the way they are shooting* [exposing] *the x- ray, even the room itself might not be fit for x-ray examinations. So I think regular visits* [by Radiation Protection Authority] *can be helpful to avoid radiation exposure to the people around. Much as we regularly have the radiation badges constantly monitored for the radiographer...we don't know what is happening with the people around."* ***[Manager]***

4.1.3.3 *Client Satisfaction*

Ercan *et al.* (2006) recommend, amongst other methods of measurement, that determining sources of satisfaction or dissatisfaction amongst patients assists in the improvement of the quality of healthcare service. Such insight, coupled with appreciation of the technical considerations – better appreciated by clinicians, rather than patients – helps to uncover the most cost-effective foci of investment to promote healthcare service benefits to the community at large.

4.1.3.3.1 *Patient Satisfaction, Dissatisfaction and Expectation*

Table 15, overleaf, summarises the views of patients on what they found to be the most satisfying aspects of, specifically, the 'existing radiological service' provision, which was predominantly based on x-ray imaging.

Table 15: Patients' Most Satisfying Aspects within the Radiological Service Provision

MOST SATISFYING ASPECTS	OPINION RATES
Availability of advanced machinery.	23 *(13.5%)*
Communication of investigations and/or findings.	18 *(10.6%)*
Friendliness of radiological staff.	90 *(52.9%)*
Combination of advanced machinery, communication and friendly staff	19 *(11.2%)*
No opinion of satisfaction	20 *(11.8%)*
TOTAL	**170 *(100%)***

The excerpts below highlight the views of patients regarding their satisfaction with the radiological services provided:

> *"I'm satisfied because they do not delay attending to people."* ***[Patient]***

> *"I'm satisfied because of good reception by the staff."* ***[Patient]***

At one hospital that recently employed more radiographers, some patients recognised the service, based on their previous experience, to have improved. This is reflected in the quotations recorded below:

> *"I'm satisfied because staff level* [number of radiographers] *has improved. They are providing quick service."* ***[Patient]***

> *"I'm satisfied; at least they are fast, not delaying people."* ***[Patient]***

Some patients had received diagnostic ultrasound services (ultrasonography), where the radiographers had performed the examinations and provided the reports – in contrast to plain film x-ray, in which no reports were provided. There were radiographers with additional qualifications to conduct ultrasonography as well as x-ray imaging. The satisfaction appeared to be more pronounced with regard to the ultrasound service provision, as reflected in the excerpts below:

"About satisfaction; ...there was excellent care by the staff [radiographer/ultrasonographer] *and proper communication of findings to the doctor."* ***[Patient]***

"I'm satisfied because I was shown the report on wellbeing of the foetus." ***[Patient]***

Some patients chose to not express a clear opinion on their satisfaction and/or dissatisfaction with the existing provision, as shown in Table 15, above. Some of these same patients, however, gave their reason for being undecided as being unsure of how the radiology department functions. These same participants, however, recognised possible adverse consequences to the limitation of radiological services. These views are illustrated in the excerpts below:

"[I am] *not sure* [whether to be satisfied or not] *because I don't know how they work,* [but] *if the radiological services are limited, there will be a lot of deaths because wrong treatment will be given."* ***[Patient]***

"...it is difficult to tell between friendly care and proper treatment... but we need proper treatment; exact treatment from x-ray result and without delay to enable attending to our own businesses quickly...or else we lose out on both [treatment and business]" ***[Patient]***

Table 16, below, identifies several aspects of patients' dissatisfaction with the **existing** radiological services:

Table 16: Patients' Most Dissatisfying Aspects within the Radiological Service Provision

MOST DISSATISFYING ASPECTS	OPINION RATES
Poor communication from the radiology personnel	67 *(39.4%)*
Long wait for radiological examination	27 *(15.9%)*
Delay in receiving results after the radiological examination	15 *(8.8%)*
No opinion of dissatisfaction	61 *(35.9%)*
TOTAL	**170** ***(100%)***

The patients' views regarding the most dissatisfying factor in the radiological services are further illustrated in the following excerpts:

> *"I'm not satisfied because the clinical officer has not told me the disease."* ***[Patient]***

> *"I'm not satisfied due to queues and no report or information from the* [radiology] *department"*. ***[Patient***

> "*I am not satisfied because of an old* [x-ray] *machine used.*" ***[Patient]***

> *"I'm dissatisfied because it has taken long to receive the result* [radiograph]*."* ***[Patient]***

Some practitioners recognised their own limitations in being able to provide effective technical information to patients. The descriptions of these limitations in technical communication are included in the quotation of practitioners' views below:

> *"Usually when the patients come to the* [radiology] *department they will try to ask questions to understand the image. So, due to the training we did; it does not allow to really express details of the image, unless they* [patients] *go back to the physician for an explanation."* ***[Radiographer]***

> *"My main concern is on the issue of interpretation. Some of us are new in this field, so you find that if there is no one who can assist you to interpret what is there, you will be stuck and as a result you can't do anything; you have to wait for the doctor to come and interpret so that I also learn....I would ask the patients to wait."* ***[Clinical Officer]***

It was noted that patients would not always appreciate the adequacy of the radiological services they had received. Some practitioner participants evaluated the ethics of their

decision-making when confronted with the dilemma of conveying the outcome of a really useful investigation, or satisfying the client with a desired duration of the investigation or short reference to a desired outcome. Such a resolution of the fundamental dilemma was seen to be more applicable to those clients who appeared to be more satisfied with an investigation that was accomplished in a shorter period of time, without regard to its technical accomplishment. It was noted, also, that levels of satisfaction varied according to individual patients' status and/or levels of literacy. The excerpts, below, suggest that there are multiple dimensions to patient satisfaction with the radiological services:

> *"Well, if the radiographer is very truthful, he or she will definitely tell the patient something, that 'we are unable to do this case because of this' although somehow may discourage the patient. But if you are not truthful about something ... you will just send away patients with worthless result to doctors … it's not good that way. It is better you consider useful radiographs regarding the patients even if they* [patients] *feel bad when we tell them the truth about our work. ...there are some radiographers who are courageous, who stick to their principles. ...Yes, patients sometimes may expect more especially in our case where we have limited machines....* [Even] *when a patient comes ...beaming confidently that I have a solution, I have to tell the patient the truth; that I am unable to do this case because of 'ABC'. Sometimes even* [other practitioners] *can confuse you by saying 'the other one was doing this using the same machine; how come you are failing to do the same?'... You offend some people when you tell them the truth …"* ***[Radiographer]***

> *"I am able to tell if the patient is satisfied because at the end of the examination, they tell you; 'thank you in the way you have attended to me...', but there are those...who will not appreciate what you have done. But you are still able to tell between those that are appreciating and those that are not appreciating. ... Usually ...we have patients from high-cost and those from low-cost. But as a radiographer ... I will see those who urgently need x-ray and not because they are from high-cost or low-cost; I will look at the urgency of the case. ...high-cost patients tend to feel overlooked* [when you don't give them preference] *despite having paid a lot of money. But I consider the conditions of patients."* ***[Radiographer]***

Some practitioners indicated that some of the causes of dissatisfaction among patients were known, and could not be locally rectified. Chiefly among these causes was waiting time due to personnel shortages, and ineffective equipment or inadequate imaging facilities. Such instances are reflected in the quotations below:

> *"Ok...normally the problem is; the patients may not be satisfied according to their expectation. There is long waiting time for patients and absence of the personnel as you are aware that we just have one staff* [radiographer] *so if he is on leave, has a problem, or it's a weekend; then the services may not be offered and therefore, patients have to wait for the personnel to come back."* ***[Clinical Officer]***

> *"I think...mostly where patients are dissatisfied is on time; because of the way we process our films* [radiographs]. *We usually dry them outside* [due to lack of automatic processor] *so you find that this takes more time and that tends to have a negative impact on service delivery to the people."* ***[Physician]***

> *"...* [Some] *patients really complain because they expect that you have to attend to them as soon as they come. ...*[but] *you have to equally consider urgency of case in what you are doing - if there is a critically ill patient I can't just overlook that patient and pick on someone else who has paid a lot of money to the hospital. So, mostly those are the people who usually complain.... Solutions to such, from what I studied; when there is a patient who is critically ill I will talk to the patient...that; 'please I need to attend to the other patient because of urgent condition, but immediately I have seen the other patient then I will attend to you....' So like that they are able to understand, since a single facility is being shared."* ***[Radiographer]***

Table 17, below, indicates the summary frequencies of identified expectations from the radiological services:

Table 17: Patients' Expectations from the Radiological Services

PATIENTS' EXPECTATIONS FROM RADIOLOGICAL SERVICES	OPINION RATES
Know what is causing the illness	60 *(35.3%)*
Should not waiting for long time	29 *(17.1%)*
Good reception and treatment	81 *(47.6%)*
TOTAL	**170 *(100%)***

Some details of the patients' expectations from the radiological services are depicted in the excerpts below:

"*My expectation is to be helped to know or understand my condition. ...be attended to by qualified staff."* ***[Patient]***

"My expectation is to be attended to fast and given the results...and communication of radiological findings'" ***[Patient]***

"My expectation is to be welcomed nicely...and to know the disease on the x-ray...the radiology staff to be explaining the findings thoroughly." ***[Patient]***

"My expectation is to receive good reception from the staff and have the result quickly." ***[Patient]***

"I expect to be seen fast, especially when in pain....radiological services to meet the demands of patients." ***[Patient]***

"I expect a result to help the doctor identify the problem." ***[Patient]***

4.1.3.3.2 *Clinician Satisfaction and Dissatisfaction*

Patients' satisfaction with the quality of healthcare service has been described to be based upon effectiveness, accessibility, interpersonal relations, continuity and amenities (Brown *et al.*, 1990). As has been indicated previously, communities, in general, cannot adequately assess technical competency. In this study the clinicians (physicians and clinical officers) were also seen as clients, and, importantly, were understood to be able to represent the patients in the evaluation of the technical competency within the radiological services. Clinicians' views were therefore understood to indicate technically-based satisfaction or dissatisfaction with the radiological services, as presented in the excerpts below:

> *"Basically I think the patients appreciate the x-ray services that we offer and know why we send them for x-ray and for your own information people have that information that x-rays are a kind of therapy. They don't really know that it is an investigation, but of course people are not sure for instance what they see on the x-ray; if we are not able to see clearly for the patients, then we will not know what to do - because all* [patients'] *eyes are on us."* ***[Physician]***

> *"The other thing I have noticed is the way results come out; sometimes they're up to the required standard but other times you may not be satisfied with the results like for chest x-ray, knowing which side is left or right."* ***[Physician]***

> *"I think they* [patients] *fail to complain* [on quality of service]*; maybe being a rural setting patient have not much understanding but what they want is the report* [on findings]*... they don't even know whether the x-ray is good or not. So for the services that are done in the radiology department I think patients are not complaining much because we attend to them in good time."* ***[Physician]***

The radiographers as providers of the radiological service commonly seemed uncertain as to whether physicians were satisfied with the radiological service they were providing. Conversely, the radiographers had their own opinions or uncertainties on the physicians'

satisfaction or dissatisfaction with radiological services. The radiographers' viewpoints in this regard are portrayed in the excerpts below:

> *"With the physicians' side, I would say the satisfaction is there if they don't send back the patient. If I have done an x-ray and the patient does not come back let's say they don't ask for 'repeat' then I know that what I did is the correct thing and the physician is satisfied with what I have done."* ***[Radiographer]***

> *"... I do not exactly know because they have never approached us to find out why we are not doing such* [specialised] *investigations; in fact they don't even request those examinations."* ***[Radiographer]***

> *"... I have seen incidences, where the patient is sent back to say do a repeat! ...the physician hasn't really appreciated what was on the x-ray...You have to go back to the physician and say this is what I have seen and both of us agree the patient does not need another x-ray..."* ***[Radiographer]***

Radiographers, in some interviews, expressed dissatisfaction with the total practitioner team effort – including that of the radiographers – in the absence of a radiologist. The challenge was seen to relate to moral considerations and the radiographers' practice limitations. The dilemma arises out of the question of whether to remain silent about a pathological pattern seen on a radiograph, which no one else seems to have noticed, or to express an opinion, as radiographer, to the physician. The excerpt below describes the dilemma clearly:

> *"Sometimes...you can see yourself sometimes a fracture or other disease; you find the patient comes to return the x-ray for filing, saying the doctor says there is no problem. But we are able to tell from the knowledge we have acquired as experts of this department – we are able to see – but because we have no powers to tell someone the problem, even if you see the problem you just keep quiet because there's nothing* [seen] *by the one* [clinician] *who is in charge."* ***[Radiographer]***

4.1.4 Human Capital Capabilities

This section focuses on the measurement of the most immediate and noticeable service-related human capital capabilities encompassing (a) technical skills, (b) adaptability to work demands, and (c) employee engagement. Of these capabilities, employee engagement is directly correlated with Human Capital Processes and encompasses professionalism. The findings are presented below:

4.1.4.1 *Technical Skills*

With regard to technical skills, it was found that although radiographers were reporting on diagnostic ultrasound, this was not the case with x-ray examinations. Hence, some participants, as in excerpts below, indicated that x-ray reporting was among the most urgently required skills for quality radiological services:

> *"... radiological reporting would be my first choice because it's like; mostly to consider the outcome after the examination, you have to report what is there especially in this place, it's like the most important part lagging behind, because sometimes even the physicians appear to be less knowledgeable on this area."* ***[Radiographer]***

> *"You find that we don't have radiologists, but you can't really comment on x-ray* [images] *even if you see that there is something wrong. When it goes to the doctor, the doctor might not even detect any abnormality - it is not that all the time they can know what's wrong or they are able to pick the wrong thing on the x-ray. But as a radiographer, you can see it [*abnormal pattern*] yet you cannot report and when you make a follow up you find that what is written is not even corroborating with what you saw on the x-ray."* ***[Radiographer]***

Furthermore, the need to have diagnostic ultrasound reporting and x-ray reporting skills among the radiographers and the overall importance of radiological services were expressed among the clinicians. The excerpts highlight the views of physicians and clinical officers:

"It's very important for our radiographers to have some expertise in ultrasound and also in x-ray reporting... especially in rural centres.... So, ultrasound and x-ray reporting should be emphasised for their importance in rural centres where we work." ***[Physician]***

"...radiology is very much essential to the patients because - you will agree with me that - some diagnoses that have to be made by clinicians are based on the x-ray [findings]. *So, you find that when you want to make a diagnosis on the part of the patient you need to use radiography. For the patients, I think they can benefit from radiography services because we need to make the diagnoses."* ***[Clinical Officer]***

Some participants expressed the view that a second opinion, by a different practitioner, would be a means of strengthening the pursuit of a definitive diagnosis among a number of differential diagnoses. This view was most favoured by clinicians and healthcare managers. In this regard, it was noted that the physicians themselves were seen to focus on their own busy schedules in the consulting rooms, wards, or operating theatres. The view also expressed that a diagnostic x-ray imaging process that did not culminate in a report was, in fact, incomplete. This view held that even basic radiological service required the inclusion of diagnostic reports among the minimum requirements. Below are excerpts on these views in support of these observations:

"...it is better we have someone who can give reports on those x-rays and then we compare with our findings." ***[Physician]***

"Two heads are better than one, so when they [radiographs] *come with reports - it is good; because those are other opinions... one can work on."* ***[Manager]***

"...sometimes in the clinical area, we are quick to look at the radiographs, especially chest x-ray. I would also like to get the [diagnostic] *report and have another opinion... I was privileged...to be in UTH* [University Teaching Hospital] *where there was a radiologist... the radiologist always writes a report. ..."* ***[Physician]***

"Yes, I think one area can be the issue of [diagnostic] *reports because it is not easy actually to get hold of a radiologist. The opinion of the radiologist will* <u>complete</u> *the investigation ...* [and not to] *end up with an x-ray image - then it's up to one to figure out! But if you have a report, the ideas can be shared and I think that will help a lot."* ***[Physician]***

4.1.4.2 *Adaptability to Work Demands*

It emerged that the radiographic training in Zambia may not be accurately addressing the discrepancies in the existing composition of the healthcare team and the expectations of other members of that healthcare team. In so doing, practitioners are seen to be assuming additional roles unofficially. Seemingly inconsistent efforts towards remedial substitution for missing skills in radiological service delivery were reported. With regard to radiological reporting, a range of diagnostic comments, often in a verbal form, were seen to be solicited from radiographers, as illustrated in the excerpts below:

"I think on ultrasound there is always a report - on the x-ray it is not always. Especially if the problem is not really coming out, we normally go back there to ask for a report.... let me give an example on a case of TB which is not clear; what we were trained and advised to do depends on the situation. If you are not clear, normally we consult both the radiology personnel and the physician and then a decision is made together." ***[Clinical Officer]***

"If a doctor requested that he or she needs a report from here, I think I will just tell him or her, looking at the way things are... [Though] *it is not our duty to tell the doctor what disease it is ...I can just give a small advice related to the condition and what is there on the radiograph..."* ***[Radiographer]***

"Fortunately for me, I have some skills on x-rays because I have some [learnt radiographic] *basics and I don't have much problem on reading of the x-ray. But because of the experience, the people I am working with always refer* [questions] *to me. It means that they would prefer a staff working at the x-ray to write a report,*

because what I'm noticing; most of the time they are coming to me when there is an x-ray query. It can be a good thing if the x-ray staff can write a report to give an advice." ***[Physician]***

Continuity of service is a recognised dimension in the quality service delivery (Brown *et al.*, 1990). Investment towards a more widespread prevalence of the needed skills among radiographers was expressed. This view related to low number and capabilities of radiographers to cope with the clinical demands. The undesirable situations where only one person possessed the needed radiological or radiographic competencies were cited among the physicians and healthcare managers. It was considered that challenges in adaptability to radiological demands required formal policy positions to ensure uninterrupted continuity and equity of healthcare services. The following excerpt supports the cited views:

"...and ensure that there is always a person to attend to these emergencies. Other than for specialised procedures, I think it's important to scale up so that not only one particular person is able to carry out some procedures. If there's a good number of people in the department able to carry out some particular procedures then it becomes easier when one person is not there; someone else may take it up and do the job." ***[Physician]***

"...we hope to get some policy... Some of the investigations currently at higher level hospitals... could be decentralised and maybe call for further training." ***[Manager]***

4.1.4.3 *Employee Engagement*

Employee engagement refers to the employee's intellectual and emotional commitment, enthusiasm and loyalty to the organisation's service goals and values. Employee engagement is known to enhance motivation and commitment among employees with respect to their roles and the general functioning of the organisation, and results in a well-informed and integrated workforce. Furthermore, this theme encourages individual contributions and fulfilment, a sense of belonging, and fosters career progression and ongoing learning (Harter, Schmidt and Keyes, 2002).

With reference to ultrasound reports, it was noted that physicians and radiographers worked together closely in pursuit of diagnoses, and that this interactive process further promoted continuous learning. The results showed a desire for collaborative engagement to be extended to x-ray investigations. The excerpts below illustrate the described interactive diagnostic and learning processes:

> *"Actually most of them* [radiographers], *do private reading* [studying] *in upgrading their skills. Sometimes the reporting* [in ultrasound scan] *is ok but I tell them - I will give an example; whereby I don't like it when someone writes 'sign of nephritis - or PID'. That* [statement] *is pathological diagnosis, which should not be written on an x-ray or a scan without describing seen sign or pattern...Usually for x-rays, we do our own reporting on the ward...I would also like to get the x-ray report to have an opinion...Because also, sometimes, in the clinical set up, we are quick especially on chest x-ray to assume 'that is TB' - not always is it TB!...the radiologists and radiographers have seen a lot of radiographs...so their opinion will be most valued."* ***[Physician]***

> *"I think on that point of view* [regarding areas of collaboration with radiographers] *...we need to embrace advanced x-ray procedures with reports ...and more detailed ultrasonography reports."* ***[Physician]***

> *"Most of them* [radiographers] *hold their profession in high regard ... usually where they are asked to do something they respond with urgency - they do it as fast as they can - and usually I tend to make sure that I do the physical clinical examination before asking for radiography."* ***[Physician]***

Some patients also viewed commitment, as evidenced by engaged employees, as an additional requirement, beyond the requirement to be trained to perform their prescribed roles as radiology staff. The excerpts, below, highlight such views:

> *"There should be qualified radiology staff, committed to work."* ***[Patient]***

"The [radiology] *department must be open all times - day and night, everyday... to cover emergencies and all of us from long distances."* ***[Patient]***

The question around the manner in which radiographers position themselves as members of a healthcare team, yielded a range of responses around a reluctance to make important radiological decisions, without their having degree qualification status. The radiographers believed that an education at degree level would support their increased competency, elevate their status and result in more appropriate remuneration. They also felt that an increased level of education and competency was necessary to improve the quality of their interaction with management. Such developments, they indicated, would enable them to be more actively engaged, as influential radiography practitioners, in the desired reorganisation of radiology departments including remote parts of the country. The excerpts below illustrate these views:

"There are certain skills; whereby a radiographer of higher qualification or degree calibre... should be participating in certain professional committees through suggestions that can improve the hospital environment. To improve hospital work, there must be radiographers in such committees; high top committees! – and should at least have some contribution in relation to their profession." ***[Radiographer]***

"...So if you can allow us to go to school, get the degree, then we are trained to interpret [radiographs] *and we are motivated – of course motivation goes with money – then like that, things will be ok. . . Actually that* [extended role training] *is what I want and I can be very happy if I can be part of those people, provided the conditions of service also changed, not just training in interpretation* [radiological reporting] - *adding more papers* [educational credentials]*."* ***[Radiographer]***

"...I contacted some radiographers in Lusaka. They agree at first but finally they refuse, I think that [accommodation] *is one of the big reasons, then the second one maybe general motivation. Some* [radiographers]*...come but as long as they are not motivated they finally go back. I think the two reasons* [accommodation and geographical location] *are the major but the most important reason is that because*

*we are in a remote area, people prefer working in town to remote areas." **[Manager]***

4.1.5 Human Capital Processes

Human Capital Processes encompass those activities associated with investment in human beings in order to derive the intended results of an organisation or department. According to the Human Capital Development model used in this study, these activities include skills appraisal, education and training opportunities, knowledge management and medical welfare. The Accenture Human Capital Development identifies, *inter alia*, career development, recruiting, workforce planning, and performance appraisal as some of the variables that need to be measured in the evaluation of an organisation's human capital processes. The data obtained from the interviews and, where appropriate, their correlation with the patient satisfaction survey and document analysis data revealed that there were gaps in some of the processes within the healthcare facilities investigated in this study.

In the interviews, the practitioners, consisting of physicians, clinical officers, radiographers and radiography assistants, collectively recognised the importance of skills in the radiology department.

4.1.5.1 *Career Development, Education and Training*

The vital role that radiology departments play within a quality healthcare delivery and the pivotal importance of radiographers heading those radiology departments without radiologists were acknowledged. Despite the evidently increased responsibility amongst radiographers, the level of the established radiographic education and training within the country was identified to be lagging behind. The desire of radiographers to primarily pursue undergraduate education and training was a persistent view.

"How can I put it? – because our profession has been lagging behind compared to other fields; you find that pharmacy, physiotherapy and the people from the lab – that is laboratory technologists; these have degree programmes within the country and it becomes easier for them to go for further training but in our field, we don't

have a degree programme so you have to go out of the country and you spend a lot of money unlike other courses." ***[Radiographer]***

"...we found that our friends [radiographers with degrees] *are used to more things like pathology learnt in details – anatomy they would go in details – ...when you are discussing with them you find that they are discussing those issues at higher level ... actually...include the component of research and management."* ***[Radiographer]***

"I think we have to make a solution to enhance our skills as radiographers. Since there are two of us there is need of letting one going for training at a time; because we know again that there is currently no such a [degree] *programme* [in Zambia] *which is also a problem. So maybe if there can be some training like the in-service training to just facilitate our knowledge."* ***[Radiographer]***

It was noted, also, that, as heads of radiology departments, some radiographers were involved in the planning of skills development within those radiology departments.

"...it's me who presented the 2011–2013 Plan for our radiology department. From 2011, I was planning CPD programmes; I said if the Government or maybe the Institution can boost or may be updating the diagnostic radiographers...; they send them to school for further training. In that case, I think that the problem of [diagnostic] *reports will end because it seems like people are not aware about the radiology department and how it functions."* ***[Radiographer]***

In this respect, some participants observed that there was a need to consider a broader range of advanced skills training than simply that of radiographic reporting. It was further emphasised that further education and training promoted positive changes in skills application amongst radiographers. These observations are highlighted in the excerpts below:

"It's difficult to single out one [priority skill]. *I can say everything mentioned; reporting, specialised examinations, advanced ultrasound; because all of them*

once they became inadequate during training, you are forced to refer to the high institutions – unfortunately higher institutions may probably have the same calibre." ***[Physician]***

"Maybe the other area is on ultrasound scanning; - [radiographers] *will need more training. We have noticed the way* [named radiographer after training abroad] *has become; we have seen positive changes in the way he is interpreting ultrasound.... We have got requests for echocardiograms.... I think with right ultrasound skills, this* [echocardiography] *should be done in the same* [radiology] *departments..."* ***[Physician]***

The Government's commitment, through the Ministry of Health and as articulated in the Public Service Training and Development Policy (PSTDP) document, is to:

"...within available resources and budgetary allocations, provide sponsorship to assist public officers to undertake short, long, full-time and long distance training and development courses which are relevant to the needs of the Public Service." **[Ministry of Health (2011)]**

The policy known as PSTDP was understood, therefore, to support the Ministry of Health (MoH) in the planning of scholarships for radiographers, and reflect the MoH's efforts towards the development of radiographic skills. A table reflecting the number of scholarships for long-term training programmes ['Table 12' of the policy] sponsored by the MoH (in 2010), however, included neither ongoing nor new radiographic sponsorships.

4.1.5.2 *Competency Management*

Competency management (CM) is known to be an important concept in human capital development management. Two different meanings of the concept may be distinguished (Janev and Vraneš, 2011). These meanings are: (1) expert competencies (specific, identifiable, definable and measurable knowledge, skills, abilities and/or other deployment-related characteristics, such as attitude, behaviour, or the physical ability necessary for the performance of an activity within a specific job context) and (2) organisational core

competencies, which are aggregates of capabilities for sustainable value and broad applicability in an organisation. Competency management, which calls for underlying analyses of skills gaps, entails the ongoing promotion of the available necessary skills, as a continuous general improvement undertaking – as in informal training – for promoting the success of individual practitioners, and the institution in the face of the realities of demands for service. The excerpts below pointed to the need for relevant competencies, underpinned by appropriated education and training, among the radiographers:

> *"Anyway, I am not sure of what the basic training would cover. They may not do all those things, but then they need short training like what we call CME* [Continuing Medical Education] *in my field... so that they can competently report."**[Physician]***

> *"It is a challenge, but I don't know if there is a deliberate programme for reporting and special investigations ... for them to be attached to a hospital with a radiologist so that they learn how to do these things* [radiological reporting and specialised investigations] *before they are posted to places where they are expected to do everything." **[Physician]***

Some participants viewed informal learning within the district or province to be inadequate without the availability of the required extended skills within the province. The excerpt below supports this view:

> *"...it would be necessary for them to have more instructions not only at the districts with other radiographers.... because here, they can interact with* [other local radiographers] *but without improving the knowledge unless they access higher skills."**[Physician]***

The excerpts from the *Technical Support Report on Radiology* document, pertaining to the Western province (Ministry of Health, 2009b), and that of a physician, respectively, revealed established intra-provincial management of competencies:

"The four hospitals that received Technical Support [TS] *include: [named four first level referral] hospitals. The nature of TS provided encompassed tests, orientation in* [ultrasound] *scans and effective use of equipment for some examinations. All the* [x-ray] *cassettes tested for efficiency simply need screen replacement and not discarding.... The test result on [named first referral] mobile x-ray machine warrants its servicing..."* ***[Radiographer]***

"In fact quite recently we have been privileged to have [named radiographer] *here, who came and at least he gave us some training...I would suggest that other than obstetrics* [ultrasound]... *we can still be helped more, especially in terms of echocardiography and abdominal ultrasound scans."* ***[Physician]***

4.1.5.3 *Workforce Planning and Recruitment*

The question on Human Capital Processes engendered an interest in the possibility that the clinical output, in terms of quality of care, might be affected negatively by inadequacies within radiology departments. As has been indicated previously, it was noted within the study that the number of radiographers in some hospitals was as low as one radiographer or no radiographer at all.

It was observed, also, that a realistic number of radiographers per district hospital and per general hospital would allow for a rotation of radiographers to take leave for training, whilst maintaining the functional integrity of the departments at all times and on all days. The excerpts, below, express participants' views on the shortage of radiology personnel:

"...we are facing a lot of challenges about x-ray [examinations]. *The first one is lack of manpower* [workforce]. *I can talk about the trained staff; since I have been in* [named district hospital] *now for more than three years, I have never worked with a trained staff* [in the radiology department] – *that one has a lot of consequences. We are very much limited; we are not able to perform our duties well."* ***[Physician]***

> *"There is a shortage of manpower* [workforce]*; the assistant who operates the machine is not well oriented in radiography. I think the one, oriented to handle radiological procedures just knows to do an x-ray but cannot read the results... There is one radiographer though sometimes he is out, an assistant helps out... At least there should be more people so that when one is away we will be able to continue receiving the services..."* ***[Clinical Officer]***

Document analysis corroborated the shortage of general healthcare workforce, as can be read within the *Consolidated Performance Assessment for Western Province* document (Ministry of Health, 2009a), as extracted below:

> *"Shortage of trained staff has continued to prevail in the districts and this has compromised the quality of care at all levels.... Staff shortage has continued to prevail at all levels. Shortage of trained staff in all the districts averages 35 percent of available staff..."* ***[Manager]***

The absence of radiographers in some hospitals was linked partially to unfavourable geographical locations and inadequate transport systems, leading to radiographers being reluctant or choosing to avoid working in such rural areas even though a "rural hardship allowance" may be offered. The remote geographical setup with respect to major cities with improved radiological technology and communication methods appeared unappealing among the radiographers. The radiographers seemed to look out for work environment and conditions with efficient mode of communication supportive to their respective planned career progressions. The excerpts highlight views on the welfare of the radiographers and need for equitable distribution of the radiology personnel:

> *"The most important recommendation that I can give as a manager; I think management is supposed to make an effort to look for radiographers. Management should ensure that radiographers' conditions* [of living] *were improved ...because the problem when people* [radiographers] *are coming they don't have assurance that they can have some minimum conditions* [of living]*... I think one of the reasons can be geographical setup...the road is very bad and everybody is not very much willing to come. Last time we had a radiographer - he came; but he didn't have an*

assurance for accommodation. So, if the management can provide minimum conditions [of living] *which can be satisfactory to the radiographer, I think we can have attraction...."* ***[Manager]***

"...The other aspect is on manpower [workforce]. *I don't know what can be done to increase manpower in the radiology department. ...trained manpower ...so that we also, who are in remote areas, get benefit from manpower; because I think the practice of medicine everywhere should be the same. So we are limited...we miss out on skilled personnel in these departments."* ***[Physician]***

Lack of radiography hierarchical staffing levels was seen as part of weakness in spearheading developments in the radiology department. This view took into cognisance the observed situation where it appeared all the radiographers were generally at the same rank without precise elevated ranks of seniority. *Ad hoc* local arrangements regarding headship of the departments for administrative convenience, appeared widespread. The preference was establishment of all the relevant positions in hierarchical order to motivate the radiographers to pursue the qualifications and competencies for appointments to such positions. The participants' views are portrayed in the excerpts below:

"...maybe the only thing I would suggest is maybe to have some sort of hierarchy, because we only have one person who is working there. So, if I am working alone in the department, there shall be no teamwork. If there were other professionals, that would be better; it can help to improve in some areas... we only have one person [in the radiology department]*."* ***[Clinical Officer]***

"*We need a plan to establish and fill in some gaps; not only the radiographer alone but we need also at least the chief radiographer to be there to oversee the department. We also need diagnostic radiographer in ultrasound to justify modern updated machines; because we cannot just stay with the same imaging but we need to go further. Special investigations are also supposed to be done."* ***[Radiographer]***

4.1.5.4 *Role Extension and Licensing*

Registration with the Health Professions Council of Zambia for extended roles in radiography was seen as one of the necessary steps to be taken to enable the provision of the necessary comprehensive radiographic services in those areas where no radiologist was available. According to the participants, such a step would encourage a number of radiographers available to undergo further training in order to enhance various skills. An indication of the required skills is reflected in the excerpts below:

> *"Actually the issue of capacity building radiographers...you know those who are willing to learn they will learn but I think the most contentious issue is the registration aspect. There is need for the Medical Council* [now Health Professions Council of Zambia] *to at least open a certain register where they will be registering these people who will be allowed to practice at that level when they have been trained to that level, whereby a person can do specialised procedures. For example, consider the clinical officers - you see. Clinical officers, I understand, now go and do medical licentiate and when they* [successfully] *finish their training they can perform minor surgeries including Caesarean Section."* ***[Radiographer]***

> *"Maybe the comments I can make is...to explain myself why I am talking about some pathology to be included; because it is difficult to have a radiologist... - the doctors specialising in radiology. Normally they are the ones who are supposed to be interpreting* [radiological imaging]*; now, it's not going to be many of them. As long as it's not easy to have many of them, they* [policy makers] *are supposed to enforce that programme for the radiographers because they* [radiographers] *already have basic radiological skills. As long as you add more anatomy and pathology, these people* [radiographers] *can assist the physicians – I know this, I'm confident!"* ***[Physician]***

Some participants felt that the issue of radiographers taking up the extended roles needs to be initiated by the radiology personnel themselves. The excerpt below reflects this view:

"Yes, the department is set up and we have people who are working there. It's up to them to iron out the issue." ***[Physician]***

"*…I think also the radiology staff must make efforts to look at everything expected…to have knowledge on everything that falls under the department of radiology …because that is the only professional we have in the department here…and just in addition I realise that in other professions like ours we have our own Continuing Medical Education; if you are in surgery you have to learn surgery...which helps us to strengthen our skills by specialisations... I wish to encourage the radiographers to engage the district or province [Medical Offices] for them also to start having continuing education or other skills initiatives..."* ***[Physician]***

According to the Health Professions Act 24 (Republic of Zambia, 2009: 258-359), with respect to a possible provision within the Act to register radiographers with the approved qualifications and competencies in extended radiographic roles, the following excerpt, under "Registration of Health Practitioners", was noted. Therefore, an appropriate new register may be determined and created:

"The Minister may, by statutory instrument, on the recommendation of the Council [Health Professions Council of Zambia], *prescribe – (a) the qualifications for registration of a person as a health practitioner; and (b) the scope of practice of health practitioners registered under this Act."* ***[Health Professions Act 24]***

4.2 PHASE TWO

Phase Two sought to plan actions to be taken towards addressing the radiological service gaps identified in the preceding phase of the study. The existing service gaps in the provision of radiological services in hospitals without radiologists were uncovered and elaborated in Phase One, as were the negative outcomes on the community arising from deficiencies in radiological skills and services. The plan of addressing these problems or challenges involved the participation of experts known to have a relationship and familiarity with the radiological service provision itself. The inclusive engagement of a

spectrum of personnel and role players served to promote a process of positive democratic change (Greenwood and Levin, 2007) within radiography practice, whilst simultaneously satisfying scientific imperatives.

The objectives in Phase Two were to (a) establish the desirable competencies and capabilities for frontline radiographers and (b) analyse relevant managements' expectations regarding these capabilities in the rendering of optimal radiological services. Questionnaires, with closed-ended and open-ended items towards feasible immediate remediation were used to further the investigation of proposed remedial action with a wider range of experts. The most prominent service-related Human Capital Capabilities, as identified in Phase One, were in the spheres of technical skills and adaptability to work demands. The outcome of this second phase was a prerequisite to the proposal of an appropriate and feasible remedial action.

4.2.1 Sample Realisation

The participants were drawn from ten categories of experts *[see Table 18]*. As in phase two exclusion criteria *[see Chapter 3];* clinical officers (n=5) and radiography assistants (n=2), that participated in Phase One, were excluded in this phase. Of the 72 questionnaires mailed to intended participants in the second phase of the study, 61 (85 percent) were returned. Two of the returned questionnaires, however, were not usable, resulting in a total of 59 (82 percent) usable questionnaires. Specifically, the unusable questionnaires had the open-ended third question left blank in all priority three parts of the question; 3.1, 3.2 and 3.3 *[Appendix 7]*. See Appendix 8 with serialised questionnaires 3 and 59 both consistently marked 'silent' under all the respective three subheadings highlighting priority order. All of the intended **categories** of radiological health practitioners participated in this phase of the study.

Among healthcare managers, six of the research population of eight (75 percent) participated, whilst the two officials from the Health Professions Council of Zambia and the single Imaging Specialist from the Ministry of Health all participated. Amongst the physicians 20 of the 29 (69 percent) possible participants participated, whereas 16 (94 percent) of the 17 radiographers and the intended two radiologists participated. All of the

intended four radiography clinical instructors participated, whereas four (80 percent) of five radiography lecturers, all intended three Radiological Society of Zambia (RSZ) officials and the single Training Standards Director participated. Table 18, below, records the realised sample, arranged in alphabetical order.

Table 18: Questionnaire Participation Involving Various Experts

PARTICIPANT CATEGORY	NUMBER OF PARTICIPANTS	RESEARCH POPULATION	PERCENTAGE PARTICIPATION
Healthcare Manager	6	8	75%
Health Professions Council officials	2	2	100%
Imaging Specialist	1	1	100%
Physicians	20	29	69%
Radiographers	16	17	94%
Radiologists	2	2	100%
Radiography Clinical Instructor	4	4	100%
Radiography Lecturer	4	5	80%
RSZ officials	3	3	100%
Training Standards Director	1	1	100%
TOTAL	**59**	**72**	**82%**

The questionnaire *[see Appendix 7]* consisted of three questions. The first question outlined two strategies that the country could possibly implement towards improving the radiological service provision in rural areas in which there are no radiology specialists. The participants were asked to comment on their personal perception of the viability of the alternatives presented. The second question sought to confirm the participants' view, as expressed in the first question, regarding the feasibility of radiographic role extension. The option was provided within this question for a possibly contrary view to the argument for extended capabilities for the radiographers. The third question required participants to identify and rank three priority workable solutions towards comprehensive, equitable and accessible radiological services in Zambia.

4.2.2 Workable Solutions towards Optimum Radiological Services in Zambia

In pursuit of the provision of an optimal radiological service provision in Zambia, 85 percent of the participants recommended an upgrade of radiographers' roles, while 5

percent recommended scheduled visits to the province by the few radiologists available in the country as the most viable option. The other participants (10 percent) thought a combination of upgrading radiographers' roles and scheduled radiologists' visits to the provinces would be favourable. Hence, an overwhelming majority of participants (n = 56; 95 percent) saw the upgrading of radiographers' roles and communication between physicians and available radiologists as either the most feasible solution, or part of the most feasible solution, to inadequate access to improved radiological services in rural Zambia *[see Table 19]*. Based on these results, Phase Two action planning was limited to those solutions which dealt directly with human capital development rather than those seen to be primarily dealing with infrastructure and equipment development from the perspective of Phase One findings.

Table 19: Participants' Recommendations for Optimum Radiological services

CLOSED-ENDED RESPONSES TOWARDS OPTIMUM RADIOLOGICAL SERVICES:	**RATES**
The few radiologists to follow schedule of visiting all areas requiring their services.	3 *(5%)*
Upgrade radiographers' roles and communication between physicians and the available few radiologists.	50 *(85%)*
A combination of the above.	6 *(10%)*
TOTAL	**59 *(100%)***

Only 20 of the 59 questionnaires included additional comments made by the participants (as the questionnaire made allowance for such comments). Here, a number of participants (n = 7) recommended an increase in the number of radiographers qualifying from the learning institutions, as well as an increase in the number of radiographers employed in the hospitals. Some participants (n = 4) favoured the acquisition of basic radiography skills among physicians and other health workers. Three participants specifically reiterated the need to introduce extended roles for radiographers as a viable option, whereas another three thought that an introduction of teleradiological services would be a viable option for the country. Each of the remaining three participants recommended, respectively, the improvement in physician-radiographer professional interaction, the improvement of radiation safety and training, and employing more radiologists.

4.2.3 Recommended Capabilities for Radiography Education and Training

Despite there being some variety in the recommendations as to the mechanism by which radiological service delivery could be improved, there were no oppositional views to the notion of extending the radiographer's role, as a component of the remedial intervention. As earlier seen, regarding sample realisation in Phase Two with respect to Phase One participation and influence to Phase Two questionnaire items, the emphasized remedial actions towards improving the radiological services was a representation of earlier 54 participants; 54 of 72 (75%) in Phase Two. The researcher, as a facilitator in Action Research, essentially, converted participants' Phase One remedial views into questionnaire items or themes in Phase Two. The themes were availed for affirmation and/or review among a larger number of practitioners towards a consensus in the desirable scope of radiological services or radiographic practice. The questionnaire contained options for possible oppositional opinions by open-ended questions. Otherwise, the researcher rigorously recognised the participants' earlier views; lest he appeared to have misunderstood or ignored the participants' proffered opinions or preferred remedial action/s.

Table 20 displays the participants' (n = 17) open-ended recommendations towards the developments of the radiographers' extended capabilities. These recommendations are additional to the recommended need to "extend radiographers' capabilities in preliminary diagnostic reports on conventional images". For optimum radiological service delivery, 95 percent of the participants *[see Table 19]* recommended upgrading radiographers' roles and diagnostic communication or with outreach by radiologists (10 percent). It could be seen from the open-ended responses in Table 20, overleaf, that other specialised radiological investigations were also recommended for inclusion to possible radiographers' extended roles. However, it was noted that the skills in diagnostic communication or reporting were still viewed as relevant in all diagnostic radiological investigations.

Table 20: Additional Views on Extended Capabilities for Radiographers

OPEN-ENDED RECOMMENDATIONS TOWARDS RADIOGRAPHERS' EXTENDED CAPABILITIES	RATES	
Place emphasis on factual [descriptive pattern] reporting.	4	*23%*
Include contrast-aided specialised investigations including fluoroscopic screening, mammography, ultrasound with echocardiography, and reporting.	8	*47%*
Equip with effective communication with radiologists and coordination of Radiologists' outreach programmes.	1	*6%*
Place emphasis on competency-based learning outcomes.	2	*12%*
Transfer some of radiographers' current roles to other health workers.	1	*6%*
Consider maintenance of radiological equipment as other possible speciality.	1	*6%*
TOTAL	**17**	***100%***

4.2.4 Interventions towards Improving Accessibility to Radiological Services

Priority-setting can pose challenges in decision-making processes in the face of a large number of urgent and competing demands (Maluka *et al.*, 2010). The open-ended third part of the questionnaire required participants to identify and rank, in the order of perceived priority, three workable interventions for improving accessibility of the community to radiological services. The first three proposed interventions of each participant were analysed for thematic commonality *[see Appendix 8]*. From a total of 170 prioritised interventions, eleven themes were identified. These identified themes are ranked in Figure 2, overleaf, and tabulated as Appendix 9.

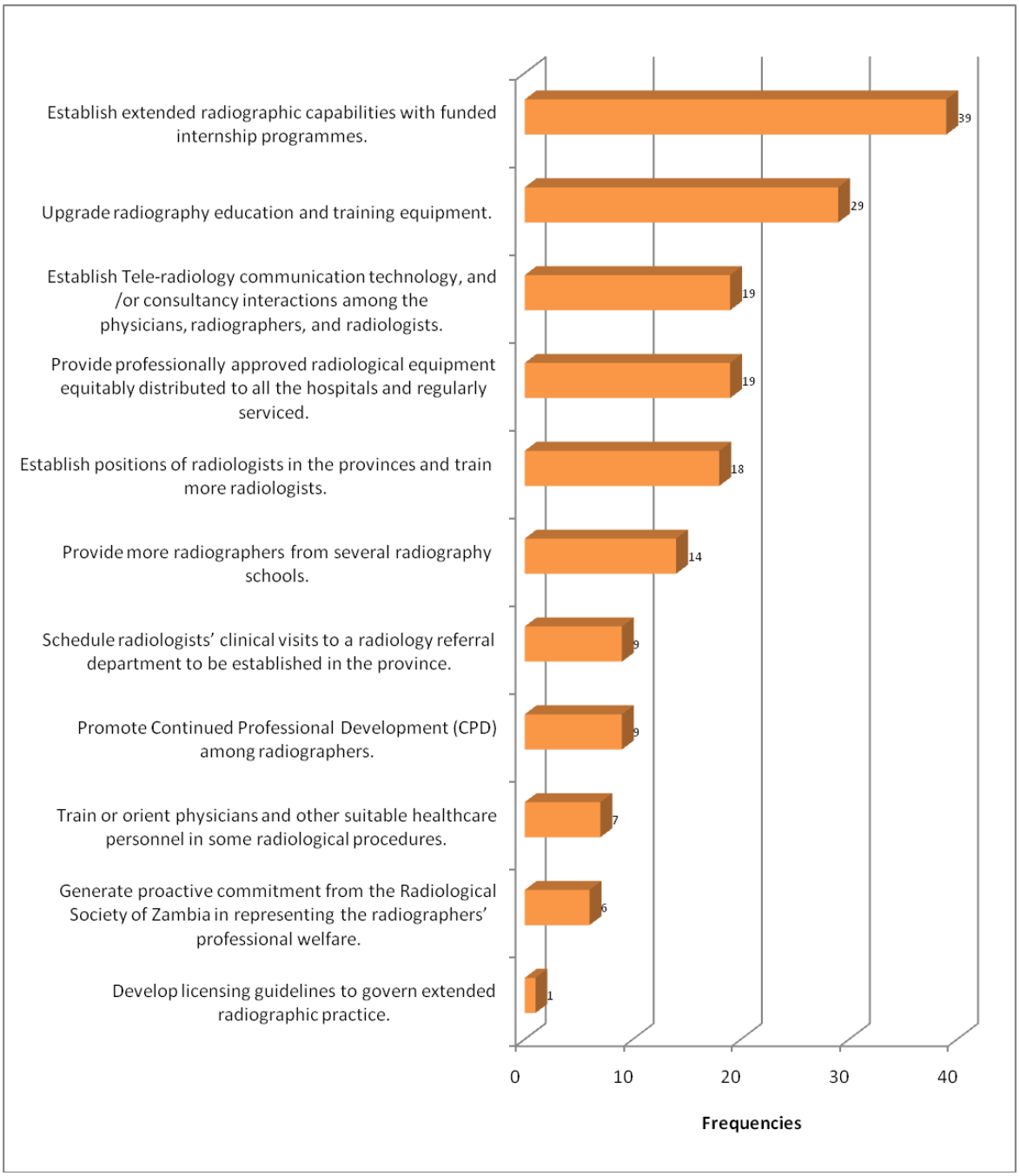

Figure 2: Ranked Preferences for Remedial Action among Participants

The participants' aggregated recommendations, as themes derived from the first three propositions for action were identified as (a) to establish extended radiographic capabilities with funded internship programmes, (b) to upgrade radiography education and training equipment, (c) to establish teleradiology communication technology and /or consultancy interactions among the physicians, radiographers and radiologists, and (d) to provide

professionally-approved radiological equipment, equitably distributed to all hospitals, and regularly serviced. The latter two themes were ranked equally as the third most commonly identified priorities.

4.3 PHASE THREE

The objective for Phase Three was to formulate and implement a training programme for radiographers as frontline healthcare practitioners within radiology departments. This phase sought to act on those recommendations arising from the preceding phase, which had involved the participation of a range of healthcare experts and representatives of healthcare management. As described above, the most recommended of the three priority recommendations on the improvement of the radiological service provision was the establishment of extended radiographic capabilities.

Amongst the varied areas for possible role extension within radiographic training, that of diagnostic reporting was identified, at this pilot phase, to be applicable in all modalities of diagnostic radiology and with diagnostic communication role between the clinicians and radiology department. In addition, conventional chest x-rays were determined as the main focus of associated clinical training, since these were noted to be the most common examinations performed in most radiology departments *[see Table 13]*. The researcher designed a training programme for radiographers with aim, objectives, content, learning outcomes and mode of delivery guided by participants' recommendations and feasible strategy of commencing to address the service gaps. As a qualified and licensed radiography teacher or trainer, the researcher was accordingly able to align the participants' recommendations into details of formal educational units based on pointers from the generated data. In view of the above, a pilot training programme entitled 'Diagnostic Pattern Recognition and Reporting for Radiographers' (DP3R) was designed and implemented.

As to whether the training conformed to the participants' preferences; the six trainee radiographers who completed the training and participated in evaluating the training programme, were participants from the commencement of the study. These radiographers employed in Western province, as the region seeking solution, participated in Phase One

(diagnosing), Phase Two (action planning), and this third phase (taking action) in the sequence shown in Figure 1. The evaluating of the training programme in the third phase ascertained the subsequent phase for evaluation of the learning outcomes to determine the appropriacy of action taken in the study.

4.3.1 Sample Realisation

Although the 17 radiographers who had participated in Phase One were invited to participate in the pilot training programme through their respective hospital Managements only eight radiographers (47 percent) participated as trainees in the initial one of four training blocks of Phase Three. These radiographers all had a diploma in radiography, Health Professions Council of Zambia registration, and experience as diagnostic radiographers ranging from one year to more than twenty years. Their participation involved travelling from their respective hospitals to Lusaka, where the residential part of training was conducted. All the hospitals that had radiographers participating in this training had other radiographic staff to ensure that radiology departments were able to run normally for the duration of training.

All the selected seven trainers participated in the training programme, whilst six out of eight trainees completed the training programme. Based on the composite assessment reports at conclusion of the first training block, two (25 percent) of the eight trainees were recommended to repeat the first learning block. However, it was not feasible to have such repeat within the planned time limits of the two months training programme. The training schedule was, however, maintained and the programme proceeded with the remaining six trainees. A total of 13 participants as trainers (n=7) and trainees (n=6), therefore, participated in the complete training programme. Of the seven participants who were trainers, six (86 percent) evaluated the training programme. The seventh trainer, being the researcher, was not eligible to evaluate the programme. All the six trainees evaluated the programme. A total of 12 participants (trainers and trainees), therefore, evaluated the piloted training programme.

4.3.2 Assessment of Radiographers' Extended Role Training Programme

Multi-skilled trainers with diagnostic reporting competencies in multiple imaging modalities were found invaluable among the trainers/assessors in this study. The trainees' average capability assessment results, from the training assessment reports, were respectively: written assignments (66 percent); written examinations (70 percent); oral presentations (70 percent); and objective structured clinical examination (80 percent). Excerpts of the views of trainers, as assessors, regarding the performance of trainees are provided below:

> *"Overall attendance and class performance was good. Due to bulky nature of the course, I would like to suggest that the radiographers come for modality-specific imaging and reporting (e.g. conducting and reporting plain films, conducting and reporting ultrasound, conducting and reporting CT [computerised tomography] etc). ...I wish them well in applying the knowledge and skills gained at their various hospitals."* ***[Consultant Radiologist]***

> *"Generally the trainees provided good oral presentations, but needed to work on demonstrating and/or acknowledging underlying evidence."* ***[Radiography Lecturer]***

Another Consultant Radiologist independently provided the following observation:

> *"Overall performance, on average, reflected good understanding of subject contents among the trainees. Otherwise there were minimum variations among the trainees' capabilities."* ***[Consultant Radiologist]***

Besides assessment of the learning outcomes, above, the training programme was evaluated, using the Training Programme Evaluation Questionnaire *[see Appendix 18]*. This questionnaire consisted of four parts that sought to evaluate the training programme in terms of, respectively, (a) aim and learning environment, (b) training resources sustenance, (c) implementation learning process and (d) forecasted outcome. A fifth question sought further elaboration on the forecasted skills and the sustainability of the training

programme. The questionnaire, consisting predominantly of open-ended questions, was completed by all participants, as identified above, once the DP3R programme was concluded. This evaluation, conducted in Lusaka, therefore, sought to shed light on the calibre and prospects of the training programme if it were to be promoted as a complete programme. The results, below, are aligned in the order of the thematic parts in the questionnaire.

All the participants (six trainers and six trainees) considered the learning environment used for the training programme to be 'appropriate'. All trainers and trainees similarly determined the aim and objectives of the programme to be 'appropriate'. However, the participants identified challenges which could hinder implementation of a full blown programme rather than the pilot. Particularly they indicated that there would be a need for more training time, student accommodation, and employer support. The participants' views are shown in the excerpts below:

> *"…did not have enough time for all practicals and testing of wide range reporting skills beyond chest x-ray…"* ***[Trainer]***

> *"There will need for optimal human and material resource base/s in harmony with learning environment for full programme, i.e. institutions, requires widening for wider practice and mentorship."* ***[Trainer]***

> *"No challenges identified so far, though larger scale training would require more dedicated resources."* ***[Trainer]***

> *"…I reckon limited time for mentorship and support from local hospitals to be an issue..."* ***[Trainee]***

> *"Designated student accommodation, and support from workplaces would be required. … lack of standardised radiology technology countrywide could also be a challenge for standardised practical tasks…"****[Trainee]***

For Training Resources Sustenance, the participants highlighted Strengths, Weaknesses, Opportunities and Threats to the training programmes, starting with **Strengths** as shown in the excerpts below, highlighting the observed position of trainees, trainers, and training environment:

> "*Students [trainees] had strength and good performance in general radiography… readily available trainees is strength too."* ***[Trainer]***

> *"There was strength in students' high competencies in clinical radiography…and eagerness to learn."* ***[Trainer]***

> *"Availability of qualified trainers was strength….with interest among students and other stakeholders would have in the training programme."* ***[Trainer]***

> *"The component of trainees' interactions sessions with consultant radiologists through presentations added strength to the programme."* ***[Trainee]***

> *"There was strength in specialised trainers and environment conducive for training."* ***[Trainee]***

> *"The whole essence of knowledge gained in pattern recognition and radiological reporting is strength for clinical application and further studies..."* ***[Trainee]***

Continuing with Training Resources Sustenance, the participants also gave their views regarding **Weakness**, where views on trainees' existing skills, fundamental knowledge, and learning time constraints were given. The excerpts below highlight the perspectives of the participants' views:

> *"Trainees were lesser conversant in newer imaging modalities, such as CT* [computerised tomography], *MRI* [magnetic resonance imaging], *and RNI* [radionuclide imaging]*."* ***[Trainer]***

"…there were inadequacies among trainees in fundamental knowledge of clinical medicine and pathology … [which] had to be enhanced for learning objectives." ***[Trainer]***

"The duration of training was insufficient for more hands-on reporting on many body regions of systems…and needed extended library hours…" ***[Trainee]***

"… I needed more practical experience on CT chest imaging and plain x-ray reporting of complicated chest conditions referred for CT…" ***[Trainee]***

The views regarding **Opportunities** indicated accessibility of trainers from local public and private institutions, visiting trainer from overseas, and varied imaging modalities. Furthermore, the training was seen as providing opportunity for advancement of radiography practice and improved patient management. The excerpts below highlight the participants' views:

"…visiting resource persons can participate in the programme, e.g. visiting radiologist took part in lecturing." ***[Trainer]***

"There are opportunities to optimise competency base among trainers … [by] blending use of knowledge in public and private practice." ***[Trainer]***

"The trainees would have chance to appreciate practical use of all available imaging modalities in Lusaka to benefit ways of referring patients...and develop radiography as a career." ***[Trainer]***

"…it can enable establishing linkages with the visiting radiologists or other visiting specialist trainers." ***[Trainee]***

"…this was insightful encouragement to advance professionally as radiographer… [with] *opportunity for recognised; interaction with clinicians, and opinion for proper patient management."* ***[Trainee]***

"…it's a preparation to fit in radiology departments with authority to report on examinations done and ability to discuss with medical officers [physicians]." ***[Trainee]***

The participants linked possible **Threats** to learning environment, continuity of training, funding to the programme, certification of qualification, support by the professional body, licensing and recognition of possible qualifications by relevant authorities. These views are expressed in the following excerpts:

"*…inability to provide suitable optimal learning environment/s can be a threat."* ***[Trainer]***

"…it a threat if the programme stops. The programme should not stop; [it] should be extended…" ***[Trainer]***

"…continuity is subject to availability of motivated qualified trainers … and whole funding to the programme." ***[Trainer]***

"…if the programme does not outline the qualification obtained after training… e.g. certificate, then there are uncertainties." ***[Trainee]***

"… if the RSZ [Radiological Society of Zambia] *is unable to facilitate the success of the programme…*[and] *if it is not recognised by Ministry of Health and HPCZ [Health Professions Council of Zambia]."* ***[Trainee]***

The participants also determined to resources (material and personnel) needed to deliver the programme, as in excerpts below:

"Good working x-ray equipment with accessories is available… and available staff is adequate to implement the programme…but financial resources would be vital." ***[Trainer]***

"*Relevant IT [Information Technology] and access to clinical radiological environment is generally sufficient…image digitizing and teleradiology facilities in rural areas for consideration…Appropriately diverse full-time and… part-time trainers currently adequate."* ***[Trainer]***

"Accommodation for trainees …and trainees' sponsorship for the whole programme to include textbooks, stationery, internet services and upkeep…" ***[Trainee]***

"Trainee sponsorship required…as supporting resources remains a challenge. The availability of teaching staff is adequate as at now…" ***[Trainee]***

In evaluation of **complete implementation** learning process, the participants provided views on learning processes, information to policy makers, and consistency of implementation between the piloted training programme and complete training programme. The views involved recommendations for adoption of the programme into a formal educational programme with mentorship to promote competencies, and delivery mode appropriate to in-service radiographers. The participants' views on the cited aspects are highlighted in the excerpts below:

"*Adopt one to one clinical mentorship, with more time given to conducting specialised investigations and training in radiological reporting. To policy makers, this programme is good for radiographers and for effective or efficient radiological services countrywide. The implementation trial has been good for intended programme."* ***[Trainer]***

"Assessment to include on site practical report writing and viva voce involving radiologists… [with] feedback from trainees and supervising officers/institutions through a dedicated coordinator." ***[Trainer]***

"I found the trial version consistent with ideal programme. For benefits of the programme to be appreciated countrywide, the Governments needs to adopt and sponsor the programme." ***[Trainee]***

"The continuous assessment and work-based learning to continue and run continuously as regular courses…though scheduled to suit working radiographers. The programme is very important and the first of its kind to my knowledge...it is so far well structured in training and assessment. Therefore…policy makers would be assisting the deprived community to embrace it." ***[Trainee]***

The evaluation of **forecasted outcome**, assisted to assess the success of the training programme in terms of learning outcomes towards service delivery. The participants cited radiographic evaluation, diagnostic radiological reporting, improved analytical skills and prospects for more extended roles were cited among the forecasted outcomes of training. The diagnostic reporting outcome was in some cases compared to ultrasonographic reporting performed by some radiographers following ultrasound training. The participants' views are highlighted in the excerpts below:

"…clinical competencies in film evaluation and reporting …with improved factual interpretative skills were reasonably achieved among trainees by completion of the programme… I expect good results from complete programme… [I am] not aware of any other similar programme for comparison." ***[Trainer]***

"…radiographers will start carrying out extended roles such as reporting…and better analytical skills as in pattern analysis and recognition for more extended roles… There is no other known similar programme in the country at the moment…" ***[Trainer]***

"…will lead to better radiological service in primary healthcare…and empowered radiographers…This [diagnostic reporting] is already being applied in ultrasound where radiographers/sonographers make reports." ***[Trainer]***

"…outcomes to enable award of certification and HPCZ [Health Professions Council of Zambia] licence....[for] certified skills in reporting on radiological images or investigations and communication with clinicians." ***[Trainee]***

"...radiographers will be empowered in diagnostic reporting...skilled in pattern recognition and report writing for effective communication." ...the competencies can be as in ultrasound training." ***[Trainee]***

The participants provided **further comments** on preferred forecasted skills and programme sustainability, where gradual implementation of skills was indicated. The skills for quality image acquisition, recognition of anatomical normal variants and predicting likely diagnoses were emphasised, as part of radiological reporting process. Additionally, skills in conduction of specialised investigations and documenting of case studies were indicated. The excerpts below outline the participants' views:

"The forecasted skills need to be gradually learnt and implemented…With good programme administration as in this project, you expect good results after the programme and therefore continuity…." ***[Trainer]***

"…underlying skills for continued successful reporting process would be; supervise or execute production of images, evaluate diagnostic quality of images, identify normal variants (deviations from typical normal) on images, and ability to predict the likely diagnosis or cause of the abnormality – in that order." ***[Trainer]***

"Specialised investigations with fluoroscopy or video screening ... including CT (computerised tomography) scanning would be forthcoming with a strong forefront in diagnostic reporting… - [though] require more practical sessions under supervision." ***[Trainer]***

"…diagnostic report training should be done frequently. The content of the programme is good, and trainees were getting better… will need more accessories, e.g. viewing boxes in the training centre where there is no disturbance…" ***[Trainee]***

"Preferred skills remain reporting on x-ray images followed by performing more contrast media studies –with reports…and documenting case studies of

interest…There should be effective communication between clinicians and radiology department, and promoted coordination with radiologists…" ***[Trainee]***

While the training programme was seen to have produced the desired outcome, an evaluation of the training programme's clinical outcome, as service in the clinical setting, was nevertheless pursued in the subsequent Phase Four of the research cycle *[see Figure 1]* for evaluation of remedial action. The relevance and sustainability of the designed training programme was, therefore, determined prior to evaluating the consequence of the action taken.

4.4 PHASE FOUR

Ford, Bach and Fottler (1997) observed that setting, controlling and changing systems or policies required robustly reliable data. Such data may include, but are not limited to, application of validated interventions, as assessed in Phase Three above, for client satisfaction. The evaluation conducted in Phase Four derived from the fifth objective of the study that was concerned with formulating, implementing and evaluating the remedial action taken in terms of its impact on optimal radiological service delivery. The formulation and implementation phases of this objective were accomplished in the third phase of the study, in which an advanced training programme for radiographers was designed and piloted.

The baseline data obtained in Phase One of the study, which related to client satisfaction ahead of the implementation of a remedial strategy was used as a basis for analysis of participants' opinions on similar themes or concepts in Phase 4 (post-intervention). Reflection upon such baseline data allowed for the determination of the effectiveness of the remedial action, and facilitated the identification of an appropriate further course of action, should deficiencies and limitations still be evidenced post-intervention.

This fourth phase of the study was, however, not intended merely to be a comparative evaluation with reference to changes in levels of client satisfaction against the diagnostic first phase. Patient or client satisfaction can be an intricate phenomenon linked to client expectation and subject to influence by changing factors (Hseik and Kagle, 1991). The

evaluation was about client (physicians and patients) satisfaction with the outcome of Phase Three interventional action. In this phase, the remedial action was evaluated to ascertain state of satisfaction among clients and possible necessary changes to the action or re-researching in line with Action Research (Wadsworth, 1998).

The radiography training programme had as its main focus radiographic reporting mainly on chest x-ray, which was identified as the most commonly performed examination in the province *[see table 13]*. Similarly, the evaluation of the training outcome focused on chest x-ray radiographic reporting. The training outcome in fourth phase was linked to the clinical impact of the trained radiographers' diagnostic reporting skills, at the evaluation conducted at a general hospital, second referral and busiest hospital among hospitals involved in Phase One.

4.4.1 Sample Realisation

The evaluation of the clinical outcome was conducted soon after delivery of a radiological service involving diagnostic chest x-ray reports at the Provincial General Hospital in Mongu. The general hospital that hosted the clinical evaluation was the largest referral hospital, of second level status, in the province. Consequently, this hospital received referred patients from the whole Western province of Zambia (Appendix 3).

In terms of the evaluation of the clinical outcome, the six radiographers who completed the training proceeded to diagnostic reporting in Phase Four. Over the two months in which the training outcome was evaluated, these six radiographers jointly issued 86 diagnostic chest x-ray reports in respect to adult patients. All of these patients (n = 86) agreed to participate in the evaluation of the radiological service received. In addition 12 of the 14 physicians (n = 12) available at the time of the fourth phase of the study participated in evaluating the quality of the radiological service provided by the trained radiographers.

4.4.2 Evaluation of Radiographers' Training Outcome as Clinical Intervention

This component of the evaluation was focused on examining the expectations, satisfaction and recommendations of clients (physicians and patients) regarding a radiological service provision that included radiological reporting. Despite the importance of the input of physicians with respect to the technical aspects of satisfaction, the evaluation was predominantly patient-focused in terms of the evaluation of the appropriateness of the service delivery. A similar assessment of the value and provision of diagnostic reports was conducted at the time of diagnosing the service gaps in Phase One of the study. In this stage (Phase Four), however, the inclusion of diagnostic reports was a specific outcome of the radiographers' training programme. The data collection tool in Phase Four *[see Appendix 20]* was, therefore, designed to replicate questions related to client satisfaction addressed in the first phase of the study. These questions pertained specifically to diagnostic radiological reporting as a common priority. The evaluation of the clinical impact and application of the training outcome necessitated the participation of physicians through self-administered questionnaires. The same questionnaire was researcher-administered among patients, in view of constraints pertaining to; literacy, illness, and/or need for translation into preferable local language.

In order to ascertain the impact of the intervention, a comparison was made between parallel interview items (between Phases One and Four) relating to the central theme of client satisfaction. The clients' expectations and recommendations were included as associated factors that had an impact on client satisfaction and the promotion of satisfaction, respectively. These considerations were pivotal to the process of improvement of the quality of the radiological service provision. The fundamental areas within the evaluation of diagnostic radiological reporting services, in this regard, centred on the responses of clients (physicians and patients) regarding:

(a) Expectation – associated with the satisfaction reference measure (Ford, Bach and Fottler, 1997) applied in the first phase interview schedules for patients (Appendix 5) and physicians (Appendix 4), and part one of the Phase Four questionnaire (Appendix 20),

(b) Satisfaction with the radiological service provision – as applied in the third part of the first phase interview schedule for physicians and patients, above, and the fourth phase; and

(c) Recommendations - as were sought in the first phase interviews, in which physicians indicated service gaps and proposed solutions, and patients proposed solutions in the second part of the interview schedules *[see Appendix 4 and Appendix 5, respectively]*. Parts two and six of the Phase Four questionnaire *[see Appendix 20]* sought similar recommendations or insights from physicians and patients towards the improvement of the chest x-ray service provision.

4.4.3.1 *Evaluation of Radiographers' Training Outcome by Patient Satisfaction*

It appeared that patients' expectations differed between Phase One and Phase Four, whilst the themes themselves remained largely comparable. Though not necessarily for comparative conclusions, due to multiple and changing faces of quality, it would be worthwhile to note possible shifts between Phase One and Phase Four under similar themes. Table 21, below, illustrates the analysis of rating regarding patients' expectation factors in Phase Four.

Table 21: Analysis of Patients' Expectations from Radiological Services

PATIENTS' EXPECTATIONS FROM X-RAY SERVICES	PHASE FOUR RATES WITH REPORTS	
• Know what is causing the illness.	66	*77%*
• Should not wait for long time.	1	*1%*
• Receive good reception and treatment.	11	*13%*
• Not certain of what to expect.	8	*9%*
TOTAL	**86**	***100%***

Some patients believed the provision of diagnostic reporting would promote the accuracy of radiological findings, and felt that the service needed to be promoted. The excerpts below highlight this view regarding expectations:

"...to have proper diagnosis of my sickness…accurate results." ***[Patient]***

"…to be properly examined and find the solution to the problem…to be examined properly and know whether the problem is treatable." ***[Patient]***

"*…to be told the problem from the report <u>every time</u> I come for x-ray….Last x-ray there was no explanation."* ***[Patient]***

Other patients looked beyond the radiological results themselves, and contemplated the importance of appropriate treatment based on correct radiological outcome. Such contemplations were predominantly expressed under the theme, 'receive good reception and treatment'.

"…to be cured, as part of following treatment, but more importantly know the disease through the x-ray report." ***[Patient]***

"…to be treated of [named illness] *following the report since in small clinics I have not been treated..."* ***[Patient]***

The aggregated 5-point scale indicated that 49 percent of patients were satisfied with the radiological service that included diagnostic reporting by radiographers. Forty four percent of patients felt very satisfied with this service provision, whilst six percent of the 86 patients that participated in the evaluation were undecided. By contrast, a seemingly outlying one participant (1.2 percent) felt 'very dissatisfied' with the service. In pursuit of an understanding of this outlying view, the other responses of this patient to questions of satisfaction or quality of service were analysed. This participant, it was found, had expected "to be attended to quickly like in the private hospitals" and had recommended "more x-ray machines" to support an accelerated rate of attending to patients. Figure 3, overleaf, illustrates the aggregated pattern of satisfaction with the radiological service that includes diagnostic reporting amongst patients:

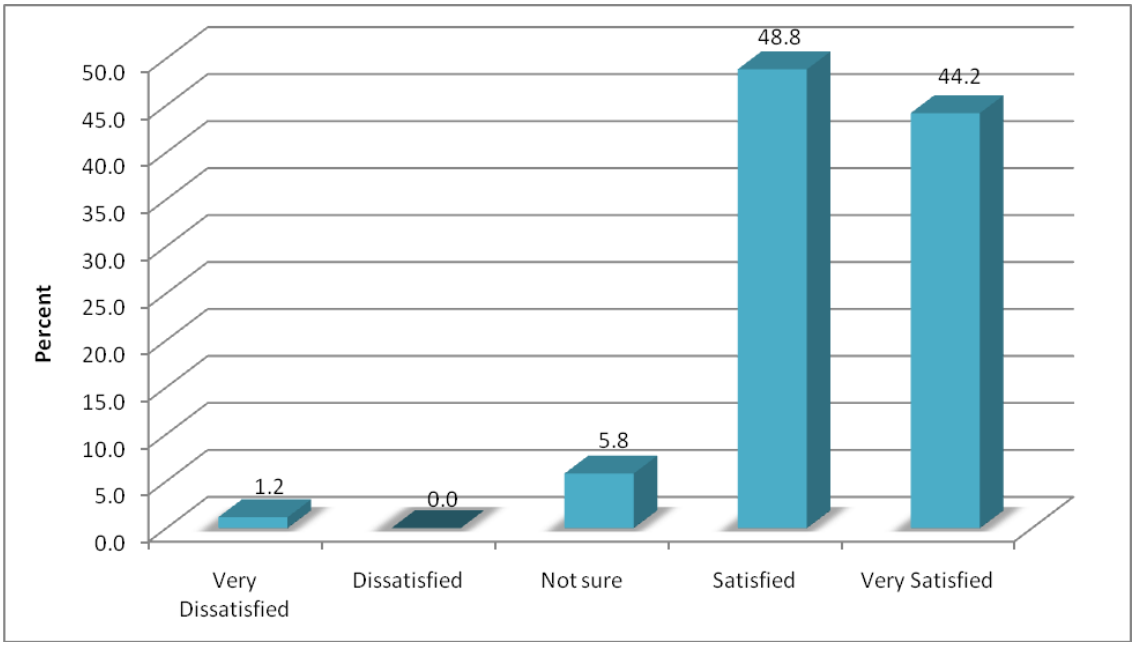

Figure 3: Patients' Satisfaction Levels with Radiological Services involving Diagnostic Reporting by Radiographers

The aggregated rating of the most satisfying part of the radiological services *[see Table 22]* was expressed as 'communication of investigations and findings/reports' (80 percent). As seen earlier *[Table 21]* regarding expectations in the service, a similar trend in service expectation and most stratifying part of the service could be drawn. The introduction of diagnostic reporting by radiographers - linked to diagnostic communication, as a new service in Phase Four could be attributed to a corresponding new theme; 'increased number of staff and short waiting time', expressed by the patients (seven percent) among most satisfying factors. One percent of participating patients expressed no opinion of most satisfying factor. The illustration of analysis pertaining to patients' satisfaction opinions in Phase Four is displayed in Table 22, overleaf:

Table 22: Analysis of Patients' Most Satisfying Factors with Radiological Service Provision

MOST SATISFYING FACTORS	PHASE FOUR RATES WITH REPORTS	
Availability of advanced machinery.	0	*0%*
Communication of investigations and findings/reports.	69	*80%*
Friendliness of radiological staff.	6	*7%*
Combination of advanced machinery, communication and friendly staff.	4	*5%*
No opinion on most satisfying factors.	1	*1%*
Increased number of staff and short waiting time.	6	*7%*
TOTAL	**86**	***100%***

From the patient data, it was noted that some patients have considered the lack of reports to be a means of withholding information from them. This position is reflected in some of the excerpts pertaining to the patients' most satisfying factors, as highlighted below:

> *"I am most satisfied because we have been given the x-ray report for the first time...unlike in the past."* ***[Patient]***

> *"I am satisfied for revealing the results to me... results are not being withheld from me."* ***[Patient]***

> *"I am most satisfied as the results are confidentially disclosed to the patients through the reports; not only shared among doctors alone."* ***[Patient]***

Essentially, most of the patients (93 percent) generally expressed satisfaction with the diagnostic reporting intervention as shown in Figure 3, above. Table 23, overleaf, features the analysis of 'least satisfying' factors among patients subsequent to receiving radiological service with diagnostic reports in Phase Four:

Table 23: Analysis of Least Satisfying Factors Subsequent to Diagnostic Reports in Phase Four

LEAST SATISFYING FACTORS IN PHASE FOUR
Poor front desk interpersonal relations or not allowed to keep the radiograph: 3 *(4%)*
Long waiting time for radiological services: 33 *(38%)*
Inadequate number of radiographers: 14 *(16%)*
None or not sure: 34 *(40%)*
No explanation of findings or reports limited to chest x-ray: 2 *(2%)*
TOTAL: 86 *(100%)*

The patients felt that there was need to increase the number of radiographers and radiological imaging facilities to improve efficiency whilst supporting the radiographers' extended roles, as implied in the patients' views below:

> *"…long lines* [queues] *due to maybe few x-ray workers* [radiographers] *attending to patients...People reading* [interpreting] *x-ray images should be many."* ***[Patient]***

> *"Few number of radiography staff processing and reporting the x-ray images and findings… Limited number of staff to read* [interpret] *the x-ray images somehow delays the process and patients."* ***[Patient]***

Once patients had experienced the x-ray service that included the provision of diagnostic reports by radiographers, they were requested to recommend ways of improving this service. This evaluation remained focused, largely, on the service associated with provision of diagnostic reports by the trained radiographers. There were suggestions among patients on how the radiological services could be improved. Table 24, below, tabulates the analysis of patients' suggestions in Phase Four, where the suggestion; "increased radiology workforce and skills" had the highest rating of 55 percent. It seemed most patients were less bothered with the "[introduction of] more x-ray rooms and machines", which rated two percent in this perspective. Conversely, the former could have been seen as an underlying factor towards appropriate range of radiological service delivery with matching x-ray rooms and machines. Table 24, overleaf, highlight the analysis of patients' suggestions towards appropriate radiological services:

Table 24: Analysis of Patients' Suggestions towards Improving Radiological Services

PHASE FOUR PATIENTS' SUGGESTIONS	PREFERENCE RATES
Increased radiology workforce and skills	47 *(55%)*
Introduce new and advanced radiology machines	--
Introduce more radiological examinations	--
Introduce more x-ray rooms and machines	2 *(2%)*
Reduce Patients' waiting time for x-ray and reports	16 *(19%)*
Not sure of any suggestion	21 *(24%)*
TOTAL	**86 *(100%)***

As earlier indicated, under 'Sample Realisation' the only second referral level hospital hosted the evaluation of clinical outcome arising from radiographers' diagnostic reports This hospital receiving referrals from the seven districts in the province *[see Appendix 2 and Appendix 3]* utilised modern x-ray machines**.** The availability of modern x-ray machines in this case**,** may account for the lack of any prioritisation of new and advanced machinery by Phase Four participants, as shown in Table 24 above.

Some patients were noted to have perceived ways to address the challenge of long waiting time and indicated mechanisms to increase the accessibility of the radiological services, which included increasing the number of x-ray machines, x-ray rooms and radiographers with improved skills. In this respect the patients are seen to have linked long waiting time to increased demand for limited radiological facilities. The patients' views are highlighted in the excerpts below:

> *"Improve levels of staff and machines or x-ray rooms, to reduce the queues [and] ...simultaneously attend to urgent cases."* ***[Patient]***

> *"Let's have many x-ray rooms and machines… X-ray reports to be done in all hospitals and clinics…"* ***[Patient]***

> *We need to have more radiography workers who can attend to patients even in small clinics to decongest the hospital."* ***[Patient]***

Patients appeared to have embraced the new radiological service in which radiographers provided diagnostic reports, and proposed ways of sustaining this service and making it more accessible. Their observations, in this regard, are reflected in the excerpts below:

> *"Expand the horizon by reporting beyond chest x-rays…Do things fast; but you can do… I know."* ***[Patient]***

> *"Widen access of improved service through more workers' participation in report making."* ***[Patient]***

> *"…do your best, as a hospital, in all areas of radiology so that as patients we benefit."* ***[Patient]***

> *"Inform people and other clinical staff about the type of disease for treatment, since in clinics they just give medicine."* ***[Patient]***

The participating patients were requested to offer further opinions on the improvement of the service that they had received *[see Appendix 20]*. It was observed that 28 of the 86 patients (33 percent) provided more opinions. Notably, these opinions appeared to emphasise those views expressed earlier within the context of improving the chest x-ray services. These views were centred on uplifting the radiographic workforce, the provision of more imaging machines, the efficiency of radiological service delivery, and emphasising the upholding of radiographers' reporting skills. The excerpts, below, summarise the pattern of patients' views:

> *"Boost the level of human resource in radiology, [and]... have more equipment and rooms for x-ray…Increase workforce to avoid long queues of patients for the services."* ***[Patient]***

> *"Train the radiography staff on reporting skills*, [and]*...employ more radiography officers in radiology service..."* ***[Patient]***

"Human capacity is a necessity… Train more staff specifically for this work; to interpret and issue reports." ***[Patient]***

4.4.3.2 *Evaluation of Radiographers' Training Outcome by Physician Satisfaction*

A reflection was made upon physicians' expectations with respect to 'technical skills', as discussed within the Phase One results. The physicians had observed that diagnostic ultrasound and x-ray reporting needed to be performed among radiographers, and reach rural communities. This suggestion, in support of extended radiographic capabilities or the role extension of radiographers, was also listed within the priority remedial preferences of practitioners in Phase Two *[Figure 2]*.

The Phase Four findings with reference to the diagnostic reports provided by radiographers indicated that nine of 12 physicians emphasised the need for radiographers to be able to provide diagnostic reports. Two of the remaining physicians emphasised the need for quality images, whilst one physician emphasised the need for patients to spend a reasonably short time accessing the x-ray services. The excerpts, below, reflect physicians' views on provision of radiographic images and diagnostic reports:

"A provision for radiographers' written reports to accompany x-ray images to compare diagnostic opinions." ***[Physician]***

"Radiographers need to offer x-ray reports or advice from the radiographs. …to write x-ray outcomes as they see them." ***[Physician]***

Although the outcome of the pilot training programme focused on chest x-ray reports, being the most common radiological investigation, it was also indicated from the physicians' expectations that diagnostic reporting should be extended beyond chest x-ray investigations. This view is excerpted below:

"… [should] *have diagnostic reports in all x-ray imaging; <u>not only</u> chest examinations."* ***[Physician]***

"*…It's encouraging to see PC [Pneumocystis Carinii] Pneumonia diagnosed and patient positively responding to Rx [treatment]…but reporting should be developed to other body systems…probably with more training; it would give better service...*" ***[Physician]***

"*Thank you for providing technical advice on chest x-ray images. How about contrast special investigations with reports and other needy areas? …e.g. consider echo [echocardiography] in your programme."* ***[Physician]***

There was also an emphasis on upholding accuracy in reporting, to avoid jeopardising clinical decision making and to ensure the professional standing of the involved practitioners is upheld. This view was in respect to the entire process from the provision of a quality radiological image to the provision of a quality radiological report. The physicians expected radiographers to ensure appropriate and technically correct imaging protocol with all the necessary radiographic projections and imaging techniques needed to be applied wherever and/or whenever applicable. The excerpts below highlight this opinion:

"…to receive x-ray reported results with all the required positions [radiographic projections] ... [and] *identity of the patient always demonstrated on the radiograph."* ***[Physician]***

"I expect interpreted x-ray images and consistency [standard protocol] *in reporting."* ***[Physician]***

The results showed that the physicians' expectations were also directed to patients' welfare regarding timely availability of results. It was expected that a reasonably short time should be spent in accomplishing radiological investigations so as to not unduly extend patients' waiting time. The excerpt below highlights this expectation:

"To spend reasonably short time so that patients should not spend a lot of waiting time." ***[Physician]***

The response to the question, 'provide your rating on the recent diagnostic reports accompanying the chest x-ray images was analysed *[see question 3 of Appendix 20]* in terms of satisfaction. All the participating physicians (n = 12) responded that they were satisfied with the trained radiographers' diagnostic comments or reports that accompanied chest x-ray images. Questions four and five sought to identify leads into, and possible explanations of, the indicated satisfaction or dissatisfaction. These questions addressed the 'most satisfying' and 'least satisfying' aspects of the service, respectively. The most satisfying factors and least satisfying factors, as these were identified by physicians in reference to their satisfaction with radiographers' reports, were analysed. Amongst the most satisfying factors identified by physicians were the radiographers' capabilities to report pathology, as well as the improved quality of the radiographic images that accompanied the reports as improved service. The excerpts below reflect physicians' most satisfying factors:

> *"Reported cases of chest pathology, such as; pattern of pleural effusion, tuberculosis, etc."* ***[Physician]***

> *"Reports with good radiographic contrast of x-ray images…improved service to patients… "* ***[Physician]***

> *"…reports with images…with good quality of x-ray imaging; helpful in pathology detection."* ***[Physician]***

In addition, physicians emphasised what they referred to as 'good' x-ray results provided in 'good' time, as most satisfying with the provided service. The expression of 'good' was attributed to the diagnostic value of these results, images and reports, provided within a convenient time. This consideration was seen to support the need to make appropriate, occasionally emergency, clinical decisions without delay. The excerpts below show this view:

> *"…continue as radiographers to adhere to quick response to x-ray requests and offering patients good conclusive x-ray services on time."* ***[Physician]***

"…measures in place to ensure x-ray investigations are undertaken and reported in good time." ***[Physician]***

It was noted that amongst the physicians' least satisfying factors were concerns related to the absence of radiological reports in some x-ray investigations. Whilst piloted radiographers' training programme was for a limited duration, subject to renewed plan for more extensive implementation following evaluation, physicians found it least satisfying that radiographers were enabled to issue only diagnostic reports of chest x-rays. As was noted in the patients' expectations presented earlier, it was seen to be preferable that radiographers' diagnostic reports consistently accompanied a wider range of diagnostic imaging. The excerpts, below, highlight the physicians' least satisfying aspects of the provided service:

"…lack of regular reports/analysis of x-rays." ***[Physician]***

"Reports not coming through in all imaging…" ***[Physician]***

In terms of the design of the x-ray report form *[see Appendix 17]*, radiographers were expected primarily to provide a factual and descriptive diagnostic 'findings' based on pattern recognition, prior to 'comment' or opinion addressing the clinical question. This was in accordance with the recommendation in Phase Two *[see Table 20]* to 'place emphasis on factual [descriptive pattern] reporting'. Further to such pattern recognition, radiographers were enabled to relate the descriptive pattern to the clinical question and possible pathology as a concluding comment. It appeared, however, that descriptive reporting alone, without a concluding comment, was found to be least satisfying and engendered the call for consistent comments that addressed pathology or clinical questions. The excerpts below were among the physicians' recommendations tabulated as Table 25, overleaf:

"Radiographers to report seen pathology, which may be missed by other clinical staff..." ***[Physician]***

"*Radiographers' indicated outcome of medical imaging with enough information to us [physician]…and suggested possible condition and differential diagnoses in some cases commendable…for comparing with other investigations like lab [laboratory] results and clinical presentation."* ***[Physician]***

"Radiography staff to provide expert position from interpretation of radiographs….express opinion on queried condition ... [and] advice on other findings or route to more imaging or further opinion…" ***[Physician]***

The evaluation process sought recommendations towards improving the outcome of the radiographers' training programme, were it to be fully implemented, based on the service provided *[see Appendix 20]*. The physicians offered a number of recommendations for improvement of the service. The physicians' recommendations are listed in Table 25, below, under related themes:

Table 25: Physicians' Recommendations following the Radiographers' Training Outcome

Radiographers' Extended Roles: • *Train in-service radiography staff in image interpretation.* • *Radiography staff to participate in offering clinical presentations on radio-diagnostic investigations and findings.* • *Train in-service radiology staff for increased capabilities.* • *Provide mentorship training for higher responsibility among radiographers.* • *Offer more specialist trainings to radiographers from proposed radiologists' outreach.* • *Equip radiographers with capabilities to guide clinicians on x-ray outcome.* • *Radiography staff to provide expert advice from interpretation of radiographs.* • *Radiographers to report seen pathology, which may be missed by other clinical staff.* • *Radiographers to indicate the outcome of medical imaging.*
Continued Professional Development: • *Hold short radiography courses periodically, as other healthcare personnel do.* • *Refresher courses should be done or provided to the radiography staff.*
Improved Quality of X-ray Imaging: • *Improved quality of x-ray images helpful in detecting pathology.*

The physicians were, in the last question, asked to provide further opinions towards improvement of the provided radiological service provision *[see Appendix 20]*. This provision was seen as a means of ensuring that participants were afforded an opportunity to express themselves adequately. Some physicians (7 of 12) offered other opinions. The following opinions were raised by at least one participant: (a) need for interaction between radiographers and physicians, (b) in-service training in image interpretation for radiographers, (c) increase in number of radiology staff, and (d) provision of diagnostic reports with x-ray images soon after imaging. To a large extent, further opinions aligned well with the recommendations already reflected in Table 25, above. The excerpts below reflect the physicians' opinions towards improvement of radiographers' training outcome:

> *"Diagnostic reports to accompany the ...x-ray image immediately* [after imaging]*."* ***[Physician]***

> *"...Radiographers to receive in-service training in image interpretation and reporting."* ***[Physician]***

> *"Interaction between clinicians and radiography staff should be promoted."* ***[Physician]***

> *"Improve staffing levels in the radiology department to accommodate efficiency."* ***[Physician]***

The described analysis of data obtained from patients and physicians, as clients of the radiological services, provided insight into the levels of satisfaction in terms of the most satisfying and least satisfying factors at the time of the study. The researcher noted that expectations and/or satisfaction factors were not static, but prone to shifting. These shifts of expectation and satisfaction factors could have been influenced by the clients' new experiences and/or knowledge with reference to the changed radiological service that included diagnostic reports. Relative to the Phase One findings, some changes in satisfaction factors emerged consequent to the introduction of the diagnostic reporting as an outcome of the radiographers' training programme - representing 'action' in this study.

CHAPTER 5
DISCUSSION

Whilst the results in this study were generated through the cyclical and sequential phases of an action research paradigm *viz.* diagnosing, action planning, taking action, and evaluating the outcome, this chapter seeks to discuss the results within the modified AHCD framework, as elaborated in previous chapters, which prioritises measurement of the effectiveness of an organisation's investment in human capital processes (Thomas, Cheese and Benton, 2003). In this regard, the discussion is therefore structured under the headings: *Radiological Service Result* – the ultimate outcome of the radiological service provision; *Performance Drivers* – the critical determinants of optimum service delivery success; *Human Capabilities* **–** the most immediate and noticeable service-related staff capabilities; and *Human Capital Processes* **–** those activities and/or policies aligned to the investment in human beings towards desirable capabilities and service outcomes. The discussion integrates the data obtained from the four phases of the Action Research cycle in terms of these same four tiers or levels of the theoretical framework.

The shortage of radiologists in Zambia makes the provision of equitable access to optimum radiological services unattainable within current Zambian radiological healthcare service practice. The emphasis placed on the investigation of strategies to promote optimum radiological services in hospitals that operate without radiologists was maintained, with specific reference to the most disadvantaged rural regions of Zambia. The purpose of the study, therefore, was to develop a framework for sustainable radiographic human capital development guidelines that encompassed a reliable and advanced radiographic practice, with special focus on those radiological settings that do not include the service of a radiologist. The objectives being to:

(a) analyse the existing radiological services and/or practices in rural Zambian healthcare facilities in the context of the Country's National Health Strategic Plan;
(b) examine the views of radiographers, physicians, and patients/clients in hospitals, regarding adequacy of radiological service delivery;

(c) determine the desirable competencies for frontline radiographers within a comprehensive radiological services delivery, as well as the presumed benefits of such competencies to the community and the health service facilities;

(d) analyse hospital managements' expectations with respect to the capabilities of frontline radiographers to render comprehensive radiological services within healthcare settings that are without radiologists;

(e) formulate, implement and evaluate a training programme to upskill radiographers, with specific references to client satisfaction and radiographic competencies; and

(f) develop a framework for the human capital development of frontline radiographers within a comprehensive radiological service provision.

The strategies or views for developing a sustainable solution to the persistently unresolved problem of the majority of radiology departments operating without radiologists are discussed. The discussion relates to contexts in which the cited problem remained unresolved. The hospitals are understood to be limited in their application of radiological technologies that are associated with the enhanced capabilities, knowledge and skills represented by radiologist, as health professionals. This situation invariably resulted in restricted quality and accessibility of comprehensive or optimum radiological services. Furthermore, the cost implications to both patients and healthcare institutions seeking scarce radiological services at distant hospitals are seen as posing negative economic impact at personal or family and national levels. Whilst the AHCDF directly links an organisation's investments in the workforce to business results, this study identified client satisfaction (in terms of both physicians and patients) to be the direct service result as expressed in terms of the quality of service delivery. The Zambian citizens themselves are seen to be the main beneficiaries of the strategy as they would no longer incur the existing expenses and delays associated with their seeking distant radiological services if service quality and accessibility were to be improved.

5.1 RADIOLOGICAL SERVICE RESULT

The Service Result was concerned with evaluating the performance of the radiology departments within the Western province of Zambia in terms of its relationship to the Zambian Ministry of Health's vision for equitable and accessible healthcare. The performance of the radiological service, in terms of this vision, is discussed under the following sub-headings: (a) accessibility of radiological services, (b) cost to patients and (c) cost to healthcare facilities.

5.1.1 ACCESSIBILITY OF RADIOLOGICAL SERVICES

In this study it was found that widespread referrals related to the need for radiological investigations not able to be provided at point of initial encounter with the radiological provision were a frequent source of anxiety among patients and their relatives or families. These referrals were also associated with delays in diagnosis and treatment of disease. Discontinuity of the healthcare service provision, arising in those instances in which patients were unable to travel to remote referral hospitals, was identified as a further negative result of the current provision. These referrals have a direct impact on the quality of the healthcare provision as cited by Brown *et al.* (1990), who have identified technical competency, access to service and continuity of the service to be among the recognised distinct dimensions of quality in any healthcare provision.

Referrals, as they were identified to occur, were further sometimes hindered by poor transport terrain, be this travelling by road or (in the wet season) by waterway. The routes between the second referral hospital in Mongu and most healthcare facilities were hardly accessible, and sometimes inaccessible, especially during the wet seasons of the year. Such inhibited transport routes were noted to be more severe in the Kalabo, Lukulu, Shangombo and Sesheke districts *[see Table 7 in Chapter 3 and Appendix 3]*. Whilst the proposed catchment population criteria for the third level hospital was set at about 800 000 people (Ministry of Health, 2005), the 2010 census (Central Statistical Office, 2011) indicated the population of Western province to be 881 524 people. Such strained catchment numbers matched the Government's population criterion *[see Table 1, Chapter 2]* that necessitated a third level radiological facility.

It was established in this study that a number of hospital referrals were due to a need for more advanced radiological investigations and/or radiological interpretation. A majority of such referrals were noted to fall within what has been identified to be a feasibly extended scope of radiographic training and practice in this era *[see Table 3, Chapter 2; Appendix 19]*. It is to be appreciated further, however, that whilst radiographers themselves can be trained towards the diagnostic interpretation of conventional radiographic images, including chest, abdomen, musculoskeletal, cardiac and contrast-aided examinations, the availability of the necessary technology or equipment would be a concomitant requirement for effective implementation. As evidenced in this study, the absence of requisite facilities and skills increased the need for referral of patients out of the province to the third level hospital, with resultant escalation of cost to the patients and involved institutions. In addition, it was noted that there was not necessarily any guarantee that such referrals would result in patients receiving the necessary urgent attention that such referrals may imply, as a result of unduly long waiting lists. The long waiting lists could have arisen from the increased demand for what is a remarkably centralised advanced radiological service provision. It was further learnt that many of the patients referred to Lusaka were unable to honour such referrals without the direct intervention and facilitation by the referring hospital, where possible, because of their own economic restrictions.

5.1.2 COST TO PATIENTS

It has to be understood that the majority of patients accessed the respective nearest hospital by way of referral from their closest health centres located in various rural locations. By way of example: a patient from Kalongola, a rural area in Shangombo district, would be referred to Senanga District Hospital, a first referral hospital, before being re-referred to a second referral hospital in Mongu. Where the required radiological services are unavailable at the second referral hospital, the patient would receive additional referral to a nearest third referral hospital in Lusaka, some 600 kilometres away *[see Appendix 19]*. It was noted in the Consolidated Performance Assessment for Western Province that such multiple referrals often resulted in ineffective communication between the referring and receiving hospitals or practitioners and had a negative impact on continuity of healthcare. Continuity of healthcare service provision is noted to be one of three dimensions of quality

healthcare delivery under Key Performance Drivers, in addition to associated safety, amenities and efficiency of service delivery (Brown *et al.,* 1990). The necessary practitioner-patient relationship and consistency of feedback information, which are additional important components of quality healthcare, were also negatively impacted upon by excessive referrals.

Patients repeatedly expressed concerns about the costs associated with need to seek services elsewhere when these services were not locally attainable. These concerns were also recognised by practitioners, who were unable to contribute constructively to the improvement of the situation. In addition, it emerged that institutional budgets themselves were strictly tailored to only cater for what were categorised as 'urgent or critical' referrals, based on exclusively clinical considerations. In this way, the community was hampered in achieving the benefits associated with the recognised role of radiological services in supporting the early detection of disease.

The direct costs associated with some radiological examinations, such as CT, coupled with the costs of transport, lodging and time spent waiting for the service, often with an accompanying relative, were seen as severely restrictive to patients. Waiting costs, in this context, include both the direct expenditure at the waiting site and the associated loss of income to individuals engaged in self-employed occupations. Practitioners expressed their recognition of the urgent need to improve service provision at district and provincial levels to obviate the need for patients to travel huge distances to receive necessary radiological services that could potentially be handled locally.

Wagstaff (2002) has maintained that illness and poverty are intertwined. As discussed previously, accessibility to an optimum healthcare service has been cited to be among the key determinants of health status and workforce productivity of a population. This perspective is linked to the question of how illness itself could lead to poverty or exacerbate existing levels of poverty in a developing country such a Zambia. With 61 percent of the population living in rural Zambia (Central Statistical Office, 2011) and involved in self-employed and subsistence means of livelihood, the need to self-fund access to optimum radiological services from a typically meagre income has a notable impact on poverty reduction or exacerbation. Such costs could potentially drive

economically vulnerable households into extreme poverty, an outcome that Meessen *et al.* (2003: 582) have recognized and termed, 'iatrogenic poverty'.

According to a study by Milimo, Shilito and Brock (2002) of the specific Zambian context, the poor communities were found to be well aware of how the additional expenditure associated with their need to seek scarce healthcare services exacerbated their poverty status. The researchers also identified different representations of poverty amongst Zambia's poor: poverty was seen as not restricted merely to income, though income was frequently mentioned, but also to include the lack of access to the range of assets and services seen to be necessary to sustain communities' respective livelihoods. Within this context, poverty may be extrapolated beyond the limitations of individual households, to include inadequacy of provision within radiology departments or healthcare institutions. Such institutions are prone to exacerbated 'institutional poverty' as they, in turn, incur additional costs associated with radiological referrals.

Kawabata, Xu and Carrin (2002) have recommended the safeguarding of populations against the high cost of healthcare through a range of social insurance strategies. Within the context of the largely self-employed populace of the Western province of Zambia, however, such strategies would still fall short of optimum radiological service provision. A wide range of important radiological services would continue to not be provided due to inadequate access to necessary finance, or not be accessed due to very limited access or unavailable subscription to health schemes.

5.1.3 COST TO HEALTH FACILITIES

An increasing demand for healthcare services worldwide creates a continuous pressure to reduce expenditure related to what are seen as 'non-core' activities (Lavy and Shohet, 2010) within healthcare facilities. The focus of healthcare expenditure would preferably be towards promoting the cost-effective utilisation of 'core' healthcare facilities and capabilities, and increasing the benefit of shared public resources to the broader community. In this study, concerns have been raised by healthcare practitioners around the frequent need for radiological referral of patients. It was observed, however, that many of these radiology-related referrals could be avoided by the focused upgrading of capabilities

within radiology departments, in terms of radiographic skills, radiological technology and radiological design.

Whilst the focus in addressing the existing challenges is on the rural areas of the country, it is foreseen that positive outcome within these areas would have a knock-on effect on third referral radiology departments through a reduction of the number of referred patients and the associated costs of such referral to the hospital itself. It was noted within this study, that referrals also occurred between hospitals at the same referral levels because of inconsistent availability of specific services or capabilities at respective referral levels. The consequence of the persistently inadequate addressing of challenges in radiological service delivery is an increasing number of patients at receiving departments at all level of the healthcare hierarchy. Such unbridled demand for services can produce unplanned congestion at receiving radiology departments and place severe strain upon limited facilities and strained budgets. With overwhelming subsequent referral to third level radiology departments, mostly to the University Teaching Hospital in Lusaka, the receiving department is left without much time for radiological innovations, such as the exploration of interventional radiology. In consequence, it has been an additionally costly challenge to families and the Zambian government to depend on radiology departments outside of Zambia for the provision of interventional radiological services.

Due to the cost implications associated with referrals, practitioners noted that hospitals do not absorb the cost of clinically non-critical patients. Yet patients who are initially regarded as ‘non-critical’ or ‘non-emergency’ may have their conditions eventually exacerbated, in the absence of immediate intervention, necessitating referral under emergency category. Healthcare managers, clinical practitioners and patients collectively felt that the operational costs of managing healthcare services would be reduced if frequent referrals to other hospitals were curtailed by appropriate remedial interventions. Until then, ‘non-critical’ patients, as have been described, would be unable to benefit from early detection and treatment of disease and have their conditions exacerbate to the levels that are either more costly to manage or beyond effective management. It is conceivable that while such patients are blind to their diagnosis and are not afforded any appropriate healthcare solution, they are bound to experience anxiety and decreased productivity which

would have an additionally negative impact on families and their socioeconomic wellbeing.

The transportation of non-critical patients for radiological referrals may be viewed as belonging to the so-called 'non-core' healthcare activities (Lavy and Shohet, 2010). The healthcare practitioners interviewed in this study were aware of the dilemma arising from the expenditure of limited resources on such activities and the effect on the funding of the core clinical business of hospitals. While healthcare institutions have an allocated budget for transportation, such allocation was seen as inadequate to the cost of transportation associated with widespread and frequent referrals. The expenses of such referrals were further compounded by the costs associated with the subsistence of accompanying health workers and the additional wear-and-tear costs of travelling on poor roads.

5.2 KEY PERFORMANCE DRIVERS

The Key Performance Drivers were viewed as the work environment and those mechanisms intended to steer or guide the desired radiological service delivery within the Western province of Zambia. At the level of radiological services, the intermediate departmental outcomes were considered and discussed in terms of (a) the quality of service delivery, (b) innovation and productivity, and (c) client satisfaction. These interrelated factors are understood to support the recognition, promotion and approval or disapproval of the quality of the radiological service provision.

5.2.1 QUALITY OF SERVICE

As posited by Ford, Bach and Fottler (1997), the measurement of the quality of an intangible service, such as the tailored application of skills and radiological technology to a wide range of radiological needs, can be a challenge. The service provider, within such a context, ordinarily dispenses the service as it is produced. This mode of provision is unlike that of the goods industry in which the manufacturer can develop quality control methods to be applied to goods already produced for clients. In the context of the evaluation of an intangible service, only the human competencies and the relevant equipment or technology can be subjected to licensure and certification, whilst the service itself is a

multidimensional and less easily defined entity. Efficiency of service implies the provision of the greatest benefit within the available resources (Brown *et al.*, 1990) and not necessarily a maximal quality of service. It was observed, in the evaluation phase of this study, that a very limited number of radiologists in association with necessary radiographic education and training for radiographers could exert a positive clinical outcome and favourable impact on certain gaps within the existing radiological service delivery.

After a two month pilot extended practice training programme for radiographers, in which radiologists participated as trainers, radiographers and trainers were noted to believe that the available training staff were adequate to implement the complete training programme. Study participants indicated that Zambia could increase the benefit derived from the limited number of radiologists and advanced practitioner radiographers within the country by encouraging the participation of both the public and private institutions in a concerted effort to optimise radiographic human capital and material resources. This approach was conceived to be a cost-effective intervention which would contribute positively to achievement of the goal of radiological service provision to even the most remote reaches of the Zambian population.

At the time of this study, numerous inadequacies in radiological service delivery were identified. Healthcare practitioners had expressed varied views regarding the implications of a persistently inadequate radiological service provision in relation to the required standard of professional practice. These inadequacies were noted to include deficiencies or lack of radiological reporting, contrast media-aided investigations, diagnostic ultrasound with echocardiography, computerised tomography (CT), fluoroscopy and digital radiography. Additionally, it was found that some radiology departments that were designated as first referral level facilities had differences of provision in terms of human capabilities and radiological technology.

It was noted that some Mission hospitals were left out in the nationwide upgrade of radiological technology or machines, based on lack of appropriately qualified personnel to handle the machines. This information emerged in the first phase of the study, thereby underscoring the importance of necessary radiological skills to influences appropriate radiological technology and service provision. The communities had limited choices for

alternative service providers such as private hospitals, particularly in rural parts of the country, mostly concentrated in urban areas. Hospitals that did not have appropriately skilled and/or qualified radiography personnel were at a double disadvantage. Such hospitals could not benefit from a national programme aimed at improving infrastructure and equipment in radiology departments. In such dilemma, the most feasible intervention was seen as residing in radiographic staff education and training. The strategy relates to radiographic human capital (Becker, 1994) as investment in radiography personnel at the centre of influencing the quality of decisively planned radiological facilities and services. Such planning would embrace Continuing Professional Development (CPD) and consequently continuing evaluation of radiological service quality. In the current era of advances in radiological technology, optimum radiological services would at least require effective application of multiple imaging modalities, including: conventional imaging with fluoroscopy and diagnostic ultrasound among other imaging methods. A single radiographer found in some hospitals, as observed in Phase One of this study, would not cope with the pressing need to provide the required twenty-four hour service in the necessary service categories such as routine, emergency and specialised radiological investigations whilst adhering to required quality, competencies and management associated with service provision.

In this study, physicians identified a need for echocardiographic investigations to be carried out in their respective hospitals. Such investigations would preferably also necessitate provision of Doppler ultrasound and a specialised training for radiographers. This call for such provision further emphasises the versatile nature of radiology departments and the need for a requisite numbers of radiographers at each hospital to enable formal learning and CPD without interrupting or compromising the radiological service provision. As it stands, Continuing Professional Development among radiographers is a mandatory requirement under the Health Professions Council of Zambia (HPCZ), regulating healthcare practice in Zambia, as espoused by the Health Professions Act 24 of 2009 (Republic of Zambia, 2009: 349-393).

Henwood (2003) has found that a non-conducive work environment would rapidly lower the output quality of a suitably qualified and competent radiographer. In view of this observed relationship, it would be prudent within the evaluation of the quality of

radiological service output to be sensitive to the interplay between radiographic competencies, appropriacy of technology and infrastructure, design of work systems, and management support enabling quality service delivery. In this study, it was noted that patients see a relationship between the inherent efficiency of the available imaging technology and the speed with which they were able to receive the service, and called for more advanced technologies. An example of such a technological inefficiency would be the use of manual image processing up to the drying stage. The more widespread application of digital radiographic imaging, in this context, would reduce the time that is associated with manual processing of radiographic images, as well as improving the quality of images as a critical prerequisite of diagnostic interpretation. Furthermore, digital radiographic imaging would effectively address issues associated with image storage, image transmission for consultation and the need for re-imaging in the absence of post-processing the image for varied clinical questions that could be addressed based on data from one x-ray exposure.

While the patients found the process of diagnostic interpretation and reporting as lowering the rate of providing the chest x-ray services in Phase Four, the physicians noted improved quality of x-ray images accompanying the reports. The patients were however satisfied with the radiographers' diagnostic reports *[see Figure 3 in Chapter 4]* and indicated need for employment of more radiographers to uphold improved service provision. Associated improvements in radiographic image quality could be attributed to compelling need among the radiographers to adhere to requisite image quality criteria to aid their determining or recognition of image patterns for interpretation and reporting. Diagnostic mage quality analysis in the process of diagnostic reporting was also underscored from the perspective of trainers, evaluating of the radiographers' training programme in Phase Three, regarding trainees' forecasted competencies.

5.2.2 INNOVATION AND PRODUCTIVITY

In their assessment of the productivity of hospitals in Botswana, Tlotlego *et al.* (2010) defined the term, 'innovation', as evolutional technical change and saw 'productivity' as the measure of the positive relationship existing between the output of a department and the associated input investment. The observed incremental increase in productivity was

linked to commensurate advances in human capital capabilities and the application of what was seen as ideal healthcare or diagnostic technology. This consideration calls for identification of the investment gaps relevant to the present Zambian radiological provision.

In the light of Maluka's caution (2011) that the evaluation of innovations and productivity within a healthcare service necessitated the upfront determination of the specific aspects of innovation and productivity that are to be evaluated, the researcher elected to focus on the nature of individual departments' radiographic capabilities. These capabilities needed to coexist with the radiological technology and infrastructure, the work protocols or guidelines that support the widening of radiographic scope, including a number of viable radiological investigations within the Zambian radiological service provision. Meanwhile, the comprehensiveness of radiography practice today can be attributed to investment in associated research, technology and skills development through education and training.

It was found that some hospitals provided patients with a choice of low-cost and high-cost intervention as an innovation towards the improvement of their healthcare provision. The researcher holds that such an innovation would be ineffectual and indeed may increase anxiety among patients, whether they have opted for low-cost or high-cost consultation, if there were not a concomitant and dedicated provision of radiological staffing and work process to deal with what would effectively be two streams of patients, with two different sets of expectations. It was within this contention that it was worthwhile to note that, in those instances in which two-tiered service offerings were available, radiographers indeed were challenged by limited facilities that necessitated patients being afforded attention based on urgency of the intervention and not on their respective high-cost or low-cost designations.

Inadequacies related to the capabilities and provision of radiographic personnel and equipment were seen to be Zambia's priority area for remedial investment in line with current global trends. At the time of the study, physicians expressed concern at the reduced capabilities of radiology departments, the inconsistent provision across individual departments and the persistent lack of needed skilled personnel.

In order for an appreciable improvement in productivity to occur within the radiological services, the evolving technical change and innovation would need to be coupled to an effective parallel human capital investment. Appropriately advanced radiographic capabilities would need to become available throughout the country, if there were to be real radio-diagnostic innovation and an associated improvement in productivity. In this way, optimal benefits would reach a majority of patients and contribute to an efficient and high-quality healthcare delivery that addresses physicians' desire for a reasonable allotment of time for making a diagnosis and initiating the treatment of patients. Such a strategy would entail requisite re-evaluation of models of education and training, improved radiological technology, reviewed work protocols and management, improved professional communication networks, such as in teleradiology, and facilitated physician-radiographer-radiologist interactions. A component of such multimodality radiological productivity would be secured through a competency-based advanced radiographic education and training that includes extended radiographic clinical roles.

As government ministries and departments budget to improve the quality of healthcare, by which is included the provision of radiological services, the question of where and how to prudently invest are cardinal questions. Within this context, the researcher contends that investment in radiographic education and training is a pivotal consideration. In this regard, the need to upgrade radiographic education and training was also highly recommended by practitioners within this study *[see Figure 2 in Chapter 4]*. Besides, investment in education and training goes beyond tuition, as it incorporates other associated support. For example, trainee radiographers who had participated in the piloted training programme cautioned that such complete training programme would be hindered by an inadequate provision of students' lodgings and a lack of appropriate financial support from employers.

Strategic or management commitment, employee involvement, appropriate technology, correct materials and a sustainable methodology to spearhead the innovations are fundamental to the global goal of ensuring equity of access to cost-effective quality radiological services as close to the family as possible (Griffin, 2002; Ritchie, 2002). The radiographers' role in the management realm is, therefore, cardinal to influence development attributes that are essentially not within the confines of the radiology department, as would be the case on planning for radiological capital investment - human

and technology - amidst competing healthcare needs. Prioritisation amongst multiple interventional needs as seen in Phase Two of this study would be worthwhile *[see Figure 2 in Chapter 4]*. Additionally, optimum use of available institutions and expertise in radiology or radiography, regardless of whether in public or private sector, was seen as cardinal by Phase 3 study participants. Radiological innovations and productivity leading to accessibility and improved quality of radiological services are commonly associated with financial or economic performance (Frogner, 2010; Aghion and Howitt, 2007).

In this study, radiographers felt there indeed was a need for radiographers to participate in certain high-impact professional and hospital management committees that would increase their capacity for radiographic professional input, and that would allow for their voice to be heard within discussions around the improvement of the hospital environment and the radiological provision as a specific component of the hospital's output. Through professional collaborations, the Zambian radiological service provision may be networked as a single interlinked unit with an adequate number of frontline radiographers, who have extended radiographic capabilities, available within all provinces of Zambia. Such frontline radiographers, equipped with the requisite extended radiographic competencies, would have appropriate communication links, such as teleradiology, with the limited number of radiologists – three radiologists at the time of this study – based in major radiology centres. Such a projected radiological service design, however, would necessitate a significant investment in radiographic human capital development processes, including necessary outreach programmes by the radiologists. It would be an organisational design for fundamental change, with a CPD strategy, favourable to avert possible barriers to intellectual, technological and further organisational innovations (Boonstra and Vink, 1996; Procter and Brown, 1997).

5.2.3 CLIENT SATISFACTION

The notion of client satisfaction incorporates overlapping psychological intangible attributes of a client's happiness, contentment or dissatisfaction and expectation of a service. Client satisfaction incorporates the cognitive and emotional aspects associated with the clients' perceptions of the service. In a more practical sense, client satisfaction may be understood to refer to the degree to which a client's desired goals and/or

expectations have been achieved (Irish Society for Quality and Safety in Healthcare, 2003). Such a conceptualisation of client satisfaction is supported further by Ford, Bach and Fottler (1997) and Hseik and Kagle (1991) who have described patient satisfaction to be an intricate phenomenon that, in the clinical context, is strongly linked to patient expectation.

As has been argued previously, an exclusively patient-centred evaluation of client satisfaction within the healthcare services has the limitation of potentially not providing sufficient insight into the more overtly technical aspects of a service provision, which may not always be obvious to the ordinary patient. For this reason, the views relating to satisfaction with the radiological services, were drawn from patients as "external clients", as well as from clinicians (physicians and clinical officers) as "internal clients" (Brown *et al.*, 1990: 12). The cognitive and emotional aspects of satisfaction are considered in this discussion with respect to the views of both clinicians and patients. The evaluation of client satisfaction was conducted at two points within the study: (a) before, and (b) after the piloted remedial intervention.

5.2.3.1 Patient Satisfaction, Dissatisfaction and Expectation

As was recommended by Ercan *et al.* (2006), the identification of patients' most desired areas of quality improvement may be derived from the prior identification of the most notable sources of satisfaction and dissatisfaction respectively. In this study, patients' recommendations for radiological improvement were correlated with the views of clinicians in terms of points of comparability and the practical and technical capacity to effect the necessary improvement. Prior to the clinical application of radiographic diagnostic reporting, the theme, 'friendliness of radiological staff', emerged as the most prominent patient satisfaction factor within the radiological services *[see Table 15, Chapter 4]*. Other patient satisfaction factors were, 'availability of advanced imaging machinery' and 'information about radiological investigations and findings'. Some patients were reluctant or unable to indicate their service expectations. This reluctance suggested that practitioners themselves may be better placed to determine the most appropriate service. One physician described his view that some patients, particularly from rural settings, do not have much understanding of a specific quality of radiological service and simply wanted a report of findings. Physicians further asserted that in such

circumstances, physicians' own judicious decision making on behalf of patients was critically important and that patients depended on physicians' understanding of what was possible within the limitations of the service. This assertion was corroborated by patients' recognition that the referrals initiated by physicians were well-intended in the absence of necessary improvements of radiological services; implying that diagnostic mistakes and wrong treatments would arise if it were not for the discretionary judgement of medical personnel.

Within the view of diagnostic radiological services being a commonly requested healthcare service, the data pertaining to selection of patients as participants in Phase One of this study indicate that the patients who received radiological services at least for the second time varied among different hospitals, in the range of 35 percent to 85 percent of the total number of patients seeking radiological services. The highest percentage was related to the second referral hospital in the province. The patients, on the basis of such previous service exposure, were able to identify improvements or deteriorations within the radiological service provision with each successive exposure and this had an impact on described satisfaction, or dissatisfaction. By way of illustration, an increase or decrease in the number of personnel within a radiology department could respectively increase satisfaction or dissatisfaction, as patients were understood to peg their expectations at the levels associated with prior exposure.

Some patients who participated in this study had received diagnostic ultrasound services, in which the radiographers routinely provided diagnostic reports, prior to the implementation of Phase Three of the study. This practice was unlike that applied to the x-ray service, in which diagnostic reporting was not offered within the province. With diagnostic reports, patients were noted to have experienced higher satisfaction with the service, attributing their improved satisfaction to a view of the diagnostic report as; a simultaneous representation of excellent care by staff, a means of proper communication of findings to doctors/physicians, and a source of comfort and reassurance to patients. Some patients, however, were noted to have experienced increased dissatisfaction at the long queues or waiting time arising within radiology departments which they partly associated with use of 'old x-ray machines'.

Towards the holistic improvement of patient satisfaction with the radiological services, emphasis ought to be placed on investment in the upgrading and extension of radiographic education and the licensed scope of radiographers, as drivers of positive change within the service provision (Payne and Rees, 1999). In this respect, the researcher noted that some clinicians in first referral hospitals and the second referral hospital within the Western province were clinical officers, below the rank of physician. The health posts and/or health centres are widespread in the province and expected to communicate with first referral hospitals and eventually the second referral hospital *[see Appendix 3]*. The clinical officers, themselves were aware of the existing dissatisfaction among the radiological service patients. They cited inadequate on-the-job radiological training as their own initiative and the need, at times, for patients to wait for the availability of a physician to interpret radiographs. The researcher notes, as has O'Driscoll (2009), that any endeavours seeking to improve levels of patient satisfaction through on-the-job training would necessitate a parallel formal learning programme to ensure reliability of radiological skills acquisition.

Radiological service quality is therefore understood to be highly dependent on both an investment in human capabilities and associated technological application within radiology or radiography. Indeed, it was observed that patients' satisfaction and/or expectations showed some shifts after the implementation of the programme that developed radiographers' skills in diagnostic reporting *[see Table 15 and Table 22; Table 17 and Table 21]*. It has to be noted that both communication of investigations and friendliness of staff borders on interpersonal relations which Crow, Storey, and Page (2003) uphold as important healthcare service factors affecting satisfaction among patients. It can be ordinary or technical interpersonal communication. Therefore, within interpersonal relations, it would be a question of which takes preference between communication of investigations and friendliness of staff. There can be underlying intertwined links, here, as communication of investigations to patients may go with practitioners' friendly attitude. Besides, the most satisfying 'friendliness' of radiological staff' in Phase One (53 percent) was determined without diagnostic reporting or communication, which seemed to have been superseded by 'communication of investigations…' involving diagnostic reporting in Phase Four (80 percent).

It can be reaffirmed that possible frequent dynamic shift of patients' expectations in radiological services, let alone shift of bases for satisfaction with the services call for recurrent methodical assessment of clients' satisfaction (Ford, Bach and Fottler, 1997; Hseik and Kagle, 1991). Therefore, the radiographers need to take time to evaluate their practice and services as an important part of healthcare service management, without getting habitually accustomed to prevailing status quo, as Gill (1995) and Evans *et al*. (2006) assert. In this way, areas of remedial intervention would take into account varied perspectives of the service to benefit the clients in line with healthcare service performance and quality of service, where service providers and clients/patients participate.

5.2.3.2. Clinician Satisfaction and Dissatisfaction

The discussion around the satisfaction with the radiological services amongst clinicians, *viz*. physicians and clinical officers, reflects their role in the quality of the service provision, with the perspective of patient-centred evaluation of service delivery. Prior to the radiographers' training, the physicians noted that radiographers were able to report on ultrasound images following training and expected them to as well report on x-ray images to aid radiological diagnoses. This expectation supported the call for role extension amongst radiographers, as reflected in Figure 2, Chapter 4 in which practitioners' priorities towards improvement of radiological service delivery are ranked.

Whilst expressing dissatisfaction with the diagnostic status quo of radiology departments, physicians indicated that it was very important for the radiographers to have some expertise in ultrasound and also in x-ray reporting to benefit the rural communities. Clinical officers, in turn, made reference to their own restricted radiological experience and described the absence or inadequacies of diagnostic reporting to be contributing to undue wasting of patients' time, the need for repeated examinations and imprecise diagnosis. Diagnostic image quality is a valuable diagnostic criterion that precedes diagnostic reporting and forms a basis for continuity, without need for repeating, of services in subsequent healthcare reviews or reassessments (Papp, 2006; McKesson Corporation, 2012). The consideration of shifting responsibility for diagnostic reporting to radiographers also emphasised their critical role in the control of image quality, in which radiographers were noted to appreciate the severe diagnostic limitations if poor

radiographs were supplied for interpretation, be that interpretation by physicians, radiographers themselves or radiologists where available.

Following the implementation of the Phase Three training programme, which was rated to be 'appropriate' to the remedial intention by both trainers and trainees *[see Assessment of Radiographers' Extended Role Training Programme, Chapter 4]*, all the physicians expressed satisfaction with the post-training clinical outcome. This view was congruous with the patients' satisfaction pattern *[see Figure 3, Chapter 4]* with specific reference to trained radiographers' diagnostic reporting competencies. Whilst the clinicians were satisfied with the radiographers' diagnostic reporting, which would be indicative of an improvement in service, the need to reduce what was perceived as an undue waiting time for patients was noted to be a persistent element of less than satisfactory service provision. One patient *[see Figure 3]* expressed anxiety at the time taken to effect radiographic service, whilst the resultant diagnostic report itself was overwhelmingly supported. The proposed remedies, such as increasing the number of radiographers, imaging rooms and increasing the efficiency of communication links with radiologists were seen to be desirable innovations, as described in an earlier section *[see section 5.2.2]*.

The piloted radiographers' diagnostic reporting outcome was focused exclusively on chest x-ray reports, being the most common radiological investigation within this context. However, there was an urge amongst clients to extend the diagnostic reporting capability to multiple investigations, for the benefit of patients. The physicians held that diagnostic reporting should include all x-ray imaging, as opposed to only chest examinations. Through this more widespread availability of reporting competency, it was felt that anxiety which patients may experience around the understanding or criterion of specific relationship between area of investigation and availability of desired service and outcome would be addressed. This more inclusive approach was articulated by patients themselves, who also called for a more extensive x-ray reporting facility amongst radiographic staff.

It was noted, furthermore, that one of the most satisfying factors identified by the physicians was radiographers' capacity to report pathology. This skill was found to be even more valued amongst clinicians, who noted radiographers' capability to report pathology that might otherwise have been missed in the absence of a diagnostic report. In

order to promote this level of radiographic capability, trainers including radiologists, in their evaluation of the training programme, recommended a radiographic basic training that included clinical medicine and pathology.

At the time of implementation of this study, radiographers were expected primarily to provide the factual descriptive component of the diagnostic report. This descriptive reporting of factually recognised radiographic patterns was seen as a narrative version of the Red Dot Scheme (Coleman and Piper, 2008; Loughran, 1994; Table 3, Chapter 2) which was subjected to interpretation for an opinion addressing the clinical question. The record of physicians' expectations consistently placed diagnostic reporting in radiology as a significant source of satisfaction, to the extent that the absence of reporting was reflected as 'least satisfying'. The physicians' recommendations for improving the piloted diagnostic reporting services *[see Table 25, Chapter 4]* were largely consistent with the practitioners' priority objective towards an optimal radiological service delivery which was to extend radiographic capability with funded internship programmes *[Figure 2, Chapter 4]*.

5.3 HUMAN CAPITAL CAPABILITIES

The Radiological Service Result, as discussed earlier in this Chapter, was concerned with measuring the ultimate performance of the radiology departments in the Western province of Zambia. The previous discussion included the key performance drivers dealing with the work environment and the mechanisms intended to guide the desired improvement in radiological service delivery. This section discusses Human Capital Capabilities, in terms of the most immediate and noticeable service-related human capital qualities necessary for critical service outcomes (Thomas, Cheese and Benton, 2003), *viz.* radiographic technical skills, adaptability to work demands and employee engagement.

5.3.1 RADIOGRAPHIC TECHNICAL SKILLS

In this study, with reference to pre-intervention Phase One and post-intervention Phase Four, it was learnt that some radiographers were engaged in diagnostic ultrasound scanning and reporting. While the patients expressed satisfaction with the reporting aspects of

diagnostic ultrasound imaging, the clinicians questioned the paucity of such doable role among the radiographers as particularly noticed in instances where such radiographers undertook formal education and training. The physicians commended the positive changes that formal ultrasound training enabled the radiographers to interpret and report diagnostic ultrasound findings. By contrast, the radiographers were only conducting diagnostic x-ray imaging without reporting. Meanwhile both diagnostic ultrasound reporting and x-ray reporting are seen or known to be within the realm of extended radiographic roles (Price, 2006) and recognised as such among the trainees in Phase Three evaluation of the piloted DP3R training programme.

In terms of participants' views, x-ray reporting was regarded as a highly required capability within the understanding of the contribution that radiology departments make in a quality healthcare provision. The 'lagging behind' of this capability amongst radiographers was identified by radiographers themselves, as well as by physicians who recognised that this skill was both lacking and yet critically important.

Multimodality radiological services, including specialised radiology such as contrast-aided examinations and echocardiography, also contribute to quality healthcare. Essentially, all diagnostic radiological examinations require diagnostic reports. Diagnostic reporting, therefore, appeared as a most immediate and noticeably lacking element of service. This consideration relates to Human Capital Capabilities in AHCDF (Thomas, Cheese and Benton, 2003) that would evidently and cost-effectively steer further improvements to service delivery. Until such time as this fundamental requirement for radiology departments is resolved, the prospect of the provision of more competency-demanding interventional radiology within departments will not be feasibly realised, without a focussed investment in local human capital development within the radiological services. The requisite associated radiological machinery already exists within the market. Goldsmith (2011) attests the availability of superior image detection, processing and display radiological technology capable of providing detailed images, which can be acquired even at short notice unlike the duration required to develop extended role competencies among the radiographers. Whilst the Zambian government could acquire such technology, as under the earlier indicated ORET project, highlighted by participants

in Phase One, the status of human input would determine the delivery of the required radiological service (Frogner, 2010) or inhibit the acquisition of required technology.

Radiological reporting process also entails assessment of quality related technical aspects of the radiological image to determine suitability of images for reporting. As noted among radiographers in the first phase of this study, lack of radiological reporting was also linked to reduced quality of diagnostic images. A similar caution was also derived among the trainers' additional comments in evaluating the radiographers' training programme with regard to production of images, evaluating diagnostic quality of images and ability to predict the likely diagnosis or cause of the abnormality. Furthermore, the evaluation of the radiographers' reporting in Phase Four highlighted an association of improved image quality to diagnostic reporting among the physicians' most satisfying factors.

The required technical skills in diagnostic x-ray or radiological reporting were lacking and/or unlicensed among the radiographers, thereby making it hard or hardly justifiable to attract modern radiological technology for mere radiological imaging, seen as incomplete service, without diagnostic reports. Despite such drawback, various models of radiographic role extension or skills development have been in existence within developed radiology departments, in developed countries, since the 1980s (Bowman, 1991; Loughran, 1994; Price 2006) up to the level of consultant radiographers (Snaith, 2011). These models, driven by an increased demand for radiological services, are typified by advances in radiological technology that are backed by commensurate advances in radiographic education and training.

The researcher contends that Zambia would be able to derive significant benefit from the adaptation of the concept of radiographic role extension to local circumstances and needs. The models of radiographic extended role practice have been typically associated with direct or on-site radiographic supervision by radiologists. Such a model takes into account a view of radiologists as the licensed practitioners and traditional experts within the practice related to some radiological roles that may be delegated to radiographers as extended roles (Rudd, 2003; Ransome, 1992). The researcher asserts that a model of supervision such as described would not be feasible within the Zambian context in which there is not a single radiologist within the Western province, despite a population of 881

524 people (Central Statistical Office, 2011) and the nearest radiologists are to be found some 600 kilometres away. The supervision of radiographers practising extended roles could be adapted to local realities through radiological clinical outreach programmes complemented by modes of Information Communication Technology (ICT) such as teleradiology.

It would be seen as feasible that radiographers in Zambia could acquire appropriate education and training to enable their taking up some of the traditional radiological roles. The capacity for radiographers to take up extended roles, such as diagnostic reporting, has a long pedigree and has demonstrated positive outcomes *[see Table 3 in Chapter 2]*. With specific reference to the Zambian context, the training programme in diagnostic reporting that constitutes Phase Three of this study, suggests a similarly positive outcome. An 80 percent accuracy rate, as determined by Objective Structured Clinical Examination (OSCE) after a two month training in diagnostic pattern recognition and reporting, was determined by the application of the radiologists' assessment standards. Loughran (1994) reported research findings of a 96 percent accuracy rate in detecting musculoskeletal trauma patterns in radiographers who had followed a six months training in musculoskeletal pattern recognition.

It has been established that, with training, radiographers are able to generate reliable diagnostic reports from real-time and cross-sectional images, in addition to static two dimensional x-ray images (Price, High, and Miller, 1997). It could, therefore, be projected that radiographers would be able to carry out various radiological investigations, including cross-sectional anatomy, real-time imaging, or contrast-aided fluoroscopy were appropriate training to be developed and offered. The consultant radiologists, within their role as trainers in Phase Three of this study, were of the view that radiographers should be strategically trained through modality-specific imaging and reporting. An example of such training would be a methodical training in diagnostic reporting involving plain radiographs, diagnostic ultrasonography and CT, respectively, according to body systems. In this way, the suggestion by physicians that it would be preferable that they compared their findings with those of someone else who has already reported on the x-ray images would be addressed in a wide range of imaging modalities. Despite the reality of there not being any radiologists within the province, physicians regarded diagnostic radiological

investigation without reports to be an incomplete investigation, emphasising, once again, the view of diagnostic reporting as part of minimum basic requirement within the radiological service provision.

Professional team-work was seen to be a possibly more prudent strategy towards strengthening the route to radiological diagnosis in the face of multiple disease patterns. The evaluated diagnostic reports in this study were generated and endorsed by two radiographers to maximise accuracy. The value of team-work was expressed by healthcare managers who seemed to favour multiple opinions towards diagnosis for reasons of diversity of perspective as well as enabling sufficient time for diagnostic analysis. Time limitations was acknowledged on over-worked clinicians, who themselves recognised the difficulties in finding appropriate allocations of time for radiographic or radiological interpretation.

Diagnostic reporting is a painstaking exercise, which does not necessarily align well with patients' general desire for prompt service. Patients expressed an expectation of being attended to promptly, being given 'the results' and for findings to be communicated efficiently. The radiographers' role in the face of such an expectation would be to carry out imaging and generate a diagnostic report responding to clinical questions posed by clinicians. The role of communicating the findings and decisions around clinical management would be left to the clinician (physician, or clinical officer). Depending on the nature of the investigation determining details of a diagnostic report, a hand written radiological report may, on average, be accomplished in ten minutes (Ferreira *et al.*, 2010), once the analysis of factual patterns in the image/s is accomplished. An interventional radiologist, Wilcox (2006), has likened radiological reporting to journalistic reporting, on the basis that both approaches require an adequate amount of time to gather facts and the requirement to report that material in written form to a reader [or referring clinician]. Notwithstanding the consideration of the urgent nature of some conditions, flawed reports on account of overly hasty reporting on the part of healthcare personnel would typically not be excused by the very same clients who would at the outset be calling for a very prompt reporting service (Smith, 1987).

An early British 'radiographer', Blackall, is said to have proposed the idea of x-ray reporting by radiographic personnel in 1924 ahead of radiological reporting becoming firmly established in the 1930s (Burrows, 1986). The idea, however, was dismissed by the medical personnel, citing low levels of radiography education and training at that time. In 1987, Martin proposed that the Red Dot Scheme of the 1980s was a mere formalisation of a longstanding phenomenon within radiology departments (Bowman, 1991; Table 3, Chapter 2). This reflection implies that radiographers have always detected or recognised radiographic pattern abnormalities as they viewed the radiographs, without necessarily communicating these due to limitations of practice authority. In this study, it was indicated, in reference to image interpretation, that radiographers often did see radiological abnormalities but, because they were not authorised to comment, they would remain silent about their opinion, even in those cases in which the abnormality may have gone undetected by the clinician. The dilemma that arises in such instances supports the argument for the upgrading of radiography education and training and formalisation of practice within extended radiographic roles according to training and approved competencies. Specific roles, such as that of diagnostic reporting, would then be performed within prescribed areas of competency and radiographers would no longer be apprehensive about unwitting charges of professional misconduct or ethical offence under the Health Professions Act 24 of 2009 (Republic of Zambia, 2009: 376) being brought against them within the routine exercising of their profession in the interests of the patients.

5.3.2 ADAPTABILITY TO WORK DEMANDS

Adaptability is viewed as a key competency that enables professionals to be successful in their careers whilst positively responding to changing demands in their professions (O'Connell, McNeely and Hall, 2008). Adaptability of personnel is associated with the accrual of relevant human capital and an organised work-environment, in pace with prevalent and changing demands. Adaptability to work demands, in this case, would relate to how radiographers direct their careers, according to both short-term and long-term plans. Adaptability is a cardinal consideration in work settings that are undergoing practice-shifts or in which the work environment is being redesigned. Appropriate evidence of adaptability relates to relevance of education, transferability of skills, the professional

experience, support offered by managements or the institutions and the inherent personal characteristics of personnel and their commitment or motivation to do the designated job.

Within this context, adaptable radiographers would see pressing demands on their services as opportunities for career growth beyond their existing employment arrangements. It has been seen that the progression of radiography was associated with *ad hoc* extended responsibility roles assigned by radiologists (Shanks, 1965; Rudd, 2003; Price, 2006; Sim and Radloff, 2008). In this study, it was learnt that radiographers did provide insight into what was visible on radiographs upon the request of clinicians, even though it was understood to not be one of their responsibilities. The prevailing clinical context, in which there are no radiologists, however, calls for radiographic education, training and practice regulations to be adapted to the clinical realities. Radiographers described feeling hampered by their restricted reporting skills, the lack of authority to provide reports and inconsistent or nonexistent channels of communication with radiologists in those instances in which radiologists' guidance was required. Patients, in turn, felt strongly that radiology departments should provide the x-ray reports. The situation might have been exacerbated by the fact that both the training of clinicians and that of radiographers were delivered in healthcare facilities with radiologists within their staff complements, yet this was not the case with hospitals where they serve upon graduation. In the radiologists' absence, it would be proposed that radiologists, who may be available only in distant hospitals, would be consulted on diagnostic opinions or appropriate radiological investigation according to the presenting clinical history, questions or circumstances, with radiographers as the backbone of departments.

The radiographers expressed an eagerness to pursue advanced radiographic education and training in order to adapt to clinical needs that require extended radiographic roles. Furthermore, the clinicians recognised that seeking radiological advice from others was worthwhile even in the absence of radiologists. Whilst it would appear that radiographers would be willing to address impromptu demands on their services, they lacked the requisite associated skills. In addition, there were sometimes limitations on the number of employed radiographers available to meet such demands. Such limitations were also seen to inhibit lone radiographers from sharing transferable radiographic skills or knowledge with peers or superiors within the profession in order to enhance professional adaptability.

Krupp and Madhivanan (2009), having studied the global challenges facing the healthcare sector, envisaged a strategically revised scope of practice, involving the reinforcement of existing work roles and the reorienting of the workforce in the interests of overcoming these healthcare challenges. The radiographic profession was seen to be amongst the professions that are following this strategy. Radiographic practice has been undergoing a developmental process, supported by technological innovations, such as computerised radiography, radionuclide imaging, magnetic resonance imaging and diagnostic ultrasound (Goldsmith, 2011). The advent of a range of radiological technologies since the 1970s *[see Table 3, Chapter 2]* has led to an emphasis on university-based radiographic education and training. With the availability of appropriate levels of education and training, radiographers have been largely successful in their adaptation to multiple imaging modalities and the associated responsibilities (Price, 2006).

Investment in radiographers' extended roles was seen as a pragmatic path within the ethical consideration of either remaining helpless with the unsatisfactory status quo, despite the knowledge of a possible remedy, or to regularise radiographers' assumption of extended radiographic roles. Radiological reports constitute the formal documentation and communication of radiological investigations and outcomes. Radiological reporting, further, underpins all forms of diagnostic radiological investigations. A radiological service backed by radiological reports is a recognisable dimension in quality healthcare service delivery, having specific relevance to the smooth continuity of healthcare service provision (Brown *et al.*, 1990). Remedial investment measures would offer redress of the ubiquitous and persistent inequity in radiological service delivery as observed in the Zambian context.

The piloted training programme was successfully adapted to participants' identified preferences *[see Figure 2, Chapter 4; Table 10, Chapter 3]*. As Price, High and Miller (1997) reported, with reference to the training of radiographers in extended roles, such a training sought to aid radiographers' adaptability to work demands arising from an increasing demand for a range of radiological functions. Amid traditional radiological practice, radiologists were compelled to advance their roles within multimodality radiology departments and to increasingly incorporate image-guided therapeutic interventional

radiology into their practice (Lesiuk et al., 2012). Advances in the range of radiographers' competencies, as an adaptation to varying clinical needs, was seen as a necessary step toward improved or upgraded radiological services. Accordingly, radiographers would ultimately adapt their work culture to align with the adopted radiological roles, hitherto confined to radiologists.

5.3.3 EMPLOYEE ENGAGEMENT

Employee engagement refers to the intellectual and emotional commitment of employees, their enthusiasm and their loyalty to the organisation's service goals and values. Employee engagement is associated with employees' motivation and commitment to work and their general organisational output or productivity (Harter, Schmidt and Hayes, 2002) and is directly proportional to the performance of a department or an organisation.

The professional attributes or motivating characteristics of radiographers may be seen as indicators of employee engagement in the sense that such attributes are linked to employees' self-directed application of skills, their enthusiasm to acquire improved skills and their levels of job-satisfaction.

In terms of the parameter of keenness to improve skills and the standing of the profession, physicians reported that, from their perspective, the majority of radiographers did private reading or studying, held their profession in high regard and were quick to respond to radiological requests. Within the context of there being no radiologists, it appeared that radiographers rose up to the challenges arising from unmet job and service expectations despite an inadequacy of skills and limited capacity for radiological mentorship within the departments. Whilst radiographers were seen to strive to upgrade their skills through on-the-job learning, this approach was found to not always be ideal or sufficient to the desired outcome, particularly when this was not supported by appropriate formal learning (O'Driscoll, 2009). Whilst the appropriate inherent human characteristics for the profession (Blundell *et al.*, 1999) existed amongst radiographers, it was felt that appropriate levels of formal education and training were required in order to enable the radiographers to be more familiar and to engage more actively in their changing roles within the radiological service delivery. It was felt by radiographers that there indeed was

a set of skills, pertaining to resolving the existing technical challenges within departments that radiographers should formally learn by means of formal education and training programmes.

Within the clinical context, radiographers received consideration and support from clinicians who were found generally to complete their physical clinical examinations before requesting radiological examinations, so as to make precise requests and to obviate additional work on the part of radiographers. Notwithstanding, these professional considerations on the part of clinicians, the lack of necessary radiological equipment in some radiology departments was seen to contribute to levels of disengagement by some radiographers who found the poor quality of equipment and infrastructural support somewhat demoralising. Within an understanding of employee engagement that sees employing institutions as having significant impact on outcomes (Saks, 2006), the role of institutional management structures to recognise and support the identified professional needs of radiographers would be of cardinal importance.

A sense of professional affiliation or partnership and progress is seen as an attribute that inspires increased levels of employee engagement (Harter *et al.*, 2002). The professional bodies that represent radiographers have an important role, *inter alia*, to collaborate closely with employing institutions on matters relating to the effective functioning of radiography practices. In this study it was found that radiographers were troubled that they were unable to exert much influence on higher management structures to effect necessary changes. It appeared that, within the centralised healthcare system, local healthcare managers were not readily able to resolve pertinent issues impacting negatively on the radiological service provision. Such issues included modernising imaging technology and infrastructural capacity, radiological equipment maintenance, and radiation safety considerations.

At the level of institutional management, radiographers felt that they should be participating in certain professional committees and be able to make suggestions towards improving the hospital environment, or minimally providing some professional input. This would be consistent with, Saks' conclusion (2006) that organisational support influenced both the engagement of employees with their profession as well as with the employing organisation.

McCauley and Broomfield (2011) have identified the leading causes of employee disengagement or distraction from fully utilising their skills as; unmet job expectation, inadequate supportive resources, skills under-utilisation or over-utilisation, inept appraisal without inspiration, lack of advancement opportunities, lack of individual recognition, unpleasant conditions of service, a disagreeable work environment, and ill-defined lines of management. Radiographers were found to feel hindered in their attempts to meet their professional expectations and had therefore become unmotivated. It was further felt that the prevailing lack of opportunities to progress within their careers, issues of salary and discontentment with their conditions of service were impacting negatively on motivation and engagement.

Employee engagement, even if the personnel welfare issues were to be addressed, would not be sustainable without a parallel improvement in professional bearing of personnel, radiological technology and infrastructure. This approach also yields benefit to service provision and the employer, in view of justifiable improved conditions of services for improved employee's competencies and service provision – commensurate with other study findings (du Plessis, Friedrich and van Tonder, 2012). In such a context, the progress of the radiographic profession would be viewed within the context of both updated radiological technology and improved levels of practice, which would result in positive feedback from clients (Evans *et al*., 2006). Physicians were noted to describe the existing situation within some radiology department in which x-ray films, or radiographs, were being dried in the open air, due to lack of an automatic processor; an inappropriate yet necessary practice that has a negative impact on service delivery.

Meanwhile, patients themselves were seen to attribute perceived shortfalls in the radiological service delivery mainly to the radiology personnel themselves, rather than infrastructural limitations such as have been described. By way of comparison, during the Phase Four evaluation of the clinical outcomes arising from the training programme, there was strongly positive feedback from those patients who had received diagnostic reports, who saw the new development as a distinct improvement on the past. Such feedback promoted radiographer engagement. As radiographers interact directly with patients, the perception of the quality of radiological service was found, often, to be associated with

their capabilities and patients were seen to address their concerns directly to radiographers within this context.

Whilst employee engagement is associated with the application of discretionary efforts to fully utilise available skills, employee disengagement, similarly, hampers individual discretionary efforts to fully utilise available skills. Within these dynamics, it should be understood that whilst employees may be competent and committed to achieving an organisation's mission and objectives, the positive aspirations of those employees would equally need to be supported. In reference to the motivation to have radiographers serve in rural regions of the country, it was found, for instance, that accommodation and geographical location served as discouragements to the objective. It would, in this context, be critically important to identify the pertinent engagement factors associated with job-satisfaction which would serve to offset those factors that may discourage engagement and inspire radiographers to serve in rural parts of the country. It appeared that the rural hardship allowance, where such was made available, was only a part of the solution amidst other factors such as increased opportunities for career development.

Nabwera, Purnell and Bates (2008) reported that some healthcare workers left their institutions for other institutions due to the lack of a supporting technical environment and scarce opportunities for professional advancement. Healthcare managers expressed concern about radiographers' work-environments, which included outdated and cumbersome machinery in some cases, technical limitations and frequent need for referral to other hospitals. Such challenges would contribute to unmet job expectations and promote employee disengagement (McCauley and Broomfield, 2011).

The status of the work-environment and the unmet job expectations that arise from a non-conducive work-environment are associated with comparative and/or competitive push-or-pull factors which are intrinsic to the movement of healthcare practitioners from developing to developed radiology departments or countries (Chimanikire, 2005). A proportion of the short tenure or exodus of radiographers from rural hospitals was seen to arise out of employee disengagement due to unmet job expectations. In this respect, careful consideration of the well-being of radiographers' deployed to rural areas, in apt work-environment, increased opportunities for professional accomplishment. For

example, improved professional communication networks, such as teleradiology, would be among factors to be considered in encouraging radiographers to serve in rural Zambia.

Radiographers felt that opportunities for their advancement in education and training, with specific reference to diagnostic radiography, would improve the calibre of radiology departments. Physicians indicated that radiographers needed to continually update their professional knowledge and skills with technical guidance from radiologists. Such technical guidance could also be sought from other suitably qualified and competent radiographers, beyond local and district levels, within the designated areas of competency.

Strong departmental leadership and vibrant professional interaction with colleagues and institutional managers may also be seen as invaluable incentives within the radiographic profession. The practice of having lone, seemingly isolated, radiographers at remote sites may be seen to contribute to radiographers' disengaging from the profession. This practice was observed to create some challenges amongst clinicians who called for some form of professional hierarchy that would enable teamwork and improve service delivery. The existing practice appeared also to promote lone radiographers' disengagement from the intricacies of their profession.

The radiographers likewise called for a plan to establish posts to fill 'responsibility gaps' in radiology departments and indicated their perception of a lack of inspiration in this regard on the part of hospital managements, that also looked to the centralised Ministry of Health headquarters in Lusaka. Clinicians supported this view of relevant responsibility or competency-based positions, and indicated that the lack of inspiration was characteristic of the entire radiographic management hierarchy. They felt inspiring radiographic hierarchy through departmental leadership, representation at the Provincial Medical Office and the Ministry of Health headquarters in Lusaka would promote professional standing.

In keeping with the observations of Pajares (1997) and Bandura (1986), the view was expressed that prevailing employee disengagement would discourage the participation of some radiographers in new learning programmes unless they were able to observe positive outcomes for participating radiographers. There were comparable views to this effect, from the assessment of the radiographers' training programme by the trainers and trainees,

where uncertainties about the training programme emerged among possible threats to the programme's sustenance. Whilst radiographers who participated in this study were routinely appraised of their performance (Ministry of Health, 2009a), the researcher contends that employee disengagement would arise if identified areas for improvement were seen to remain unresolved at the time of subsequent appraisal. In addition, radiographers indicated the need, through the Radiological Society of Zambia, for the piloted training programme to be recognised and endorsed by the Ministry of Health and the HPCZ. In this way, radiographers predicted a renewed recognition and improved perception of the radiographic profession within the healthcare team.

5.4 HUMAN CAPITAL PROCESSES

Human Capital Processes constitute activities that invest in human beings for the ultimate benefit of an organisation or department. Human capital, itself, has been defined as "the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" (Organization for Economic Cooperation and Development, 2001: 18). In this regard, Human Capital Processes, encompass career development, education and training, competency management, workforce planning and recruitment, and role extension and licensing.

5.4.1 CAREER DEVELOPMENT, EDUCATION AND TRAINING

Freire, an educational theorist, has emphasised that the disadvantaged need not be merely incidental to the curiosity of researchers (Kolb, 1984). As evidenced in the preceding chapter, physicians, radiographers and patients alike are disadvantaged by the lack of radiologists and the associated deficiencies of service. The investigation of the deficiencies within what is arguably a critical component of any healthcare provision calls for critical reflection upon the myriad and multidimensional factors that contribute to the prevailing situation, such as the historical radiological background and its related technology and levels of education and the associated competencies. There is, furthermore, a need to establish a desirable standard of radiographic practice that seeks to address such contextual radiological service deficiency.

In this study, radiographers noted that their profession had lagged behind for some time and had not experienced the benefits of the ongoing global evolution of radiographic practice, most notably in the rural regions of the country. They noted also that, unlike the professions of pharmacy, physiotherapy and laboratory technology, radiographic education and training was not offered at degree level within the Country. This limited access to local radiographic education and training necessitated travel to other countries and required access to considerable financial resources if radiographers wished to pursue further training.

Price (2006) investigated the role of education in supporting radiographic practice and new elements of radiological operation. He reported that undergraduate education was important to prepare radiography trainees in the skills necessary beyond their first qualification and professional registration, associated with postgraduate education and training. Some of the radiographers that participated in this study were cognisant of the significance of degree level radiographic education through their interaction with radiographers who had undergone this level of education. They cited detailed study of anatomy and understandings of research and management as specific areas of increased knowledge. Postgraduate education and training was identified as being fundamental to steering new forms of clinical practice.

In the global context, the evolution of radiographic education was developed to university degree level by the 1980s (Bowman, 1991; *see Table 3, Chapter 2*). The current extension of radiographic roles has similarly been promoted since the 1980s and firmly established by 2009 (Snaith, 2011). Price (2006) has cited imaging-related intravenous injections, gastrointestinal barium studies and conventional x-ray reporting and ultrasonography to be among the extended roles within radiographic practice. There have been a number of variations in the methods of training towards extended radiographic roles, but the mainstay approach has been one of in-house or on-the-job training.

Existing learning institutions in Zambia are able to promote advances in radiographic practice. However, the participation of the Radiological Society of Zambia (RSZ), as the professional body, may be viewed as a critical driver of a desired trainee internship. The need for such participation by RSZ was expressed by participants in this study, who saw

RSZ's role in promoting radiographers' examinable competencies for professional registration as being indispensible. O'Driscoll (2009) has noted that the initial learning of skills requires long and formal learning, rather than what is typically provided by on-the-job training. Formal learning was seen as an invaluable foundation upon which in-house or on-the-job learning could allow for realistic adaptation of competencies to varying circumstances. Within this context, formal and informal learning (in the form of on-the-job training), respectively could be likened to bricks and mortar in building a house (O'Driscoll, 2009). Short-duration informal learning by way of CPD is therefore not interchangeable with longer periods of formal learning. Indeed radiographers in this study recognised that short in-service CPD training served to merely update knowledge and skills.

In order for actively-serving radiographers to pursue formal education and training there would need to be an adequate number of radiographers to allow for alternating opportunities for studies within respective departments. Such a consideration would enable radiographers to attend studies without compromising the operation of the radiology department. Radiographers were mindful of the need to keep both radiology departments and their studies viable. In case of two radiographers who were serving in a single department, the understanding amongst radiographers was to allow one to undergo training at a time. However, they also expressed concern that there was no degree programme on offer within Zambia, at the time of this study.

The challenges faced by radiographers who worked alone, without back-up during absence from their departments, to undertake training were highlighted. The lone radiographer would be responsible for both the clinical and administrative aspects of the department, as seen in Phase One, which included preparation of departmental strategic plans for the hospitals. Such radiographers planned for CPD programmes meant to be approved by healthcare managements for seeking Government support. Based on Phase Three trainees' evaluation of the radiographers' training programme, the radiographers needed the programme to run as a fully fledged regular programme with work-based modes of learning to suit working radiographers. The radiographers saw such a learning approach, supported by appropriate policies and investment, as beneficial to communities, radiographers, and Government towards quality radiological service delivery. The

provision of a formal in-service training for actively-serving radiographers was seen as a means of promoting an essential cost-effective responsiveness to service and professional developments with capacity to effectively adapt to emerging service demands.

In the pursuit of participants' identified preference to establish extended radiographic capabilities with funded internship programmes, Governmental investment in radiographic human capital development would be seen as paramount. Such investment could take the form of funding for degree-level radiographic education and training, CPD, and funding of clinical equipment and administrative costs. In the meantime, the definition and ranking of radiographers' competencies in extended roles were seen as being essential to the accreditation of such practice by the licensing body, the HPCZ. In this way, the progression of the advanced profession practice would be registered and regulated. The radiology departments would then be able to contribute to advancing the quality of healthcare delivery, in contrast to inept radiology departments that would have a possibly negative or doubtful impact on important clinical decisions that require radiological input. An escalation of the pace of such radiographic practice would require appropriately competent radiographers performing multimodality clinical radiographic duties which include elements of research and management. Existing university degree programmes (that could be contextualised to Zambia) currently provide management and research modules associated with problem identification and solving skills such as would be required in effective radiographic practice (Price, 2006).

Investment in the infrastructure and equipment of radiology departments was identified to be among the recommended requirements towards supporting clinical training within the process of optimising the radiological service provision. A recommendation from among the participants was to upgrade radiographic education and training equipment as well as to provide professionally approved and regularly serviced radiological equipment to all hospitals *[see Figure 2, Chapter 4]*. Whilst supporting formal clinical training and internship, this consideration was also seen to be promoting clinically-based CPD. This perspective was supported further by radiographers within the training programme by their concern that the lack of standardised radiology technology countrywide would challenge some trainees in their desire to extend their capabilities. In the interest of sustainability of the training programme, radiographers were identified to need to be optimally trained to

recognised certification levels, which would also add to availability of licensed clinical trainers or mentors in successive training programmes. Besides, trainers and training institutions or facilities would be considered from both public and private sources. Basic clinical medicine with detailed pathology and anatomy, including cross-sectional anatomy, were recommended as essential to frontline clinical radiographic practice, for effective diagnostic communication and clinical considerations prior to involvement of consultant radiologist when desirable.

Information Communication Technology (ICT) in the form of teleradiology, and associated digital imaging could facilitate professional interaction among the radiologists, radiographers and physicians. The use of such technology was listed amongst the preferences by participants to improve radiological service delivery and was seen as a means by which radiographers with extended roles could access necessary guidance from scarce and distantly located radiologists *[see Figure 2, Chapter 4]*. In addition, such interactive communication technologies could potentially aid the CPD of radiographers through the easy storage and dissemination of digital or electronic images. Furthermore, the prevailing experience of isolation amongst radiographers in rural regions of the country could be ameliorated through the facilitation of inter-professional and intra-professional interaction that the application of these technologies affords. In this study, some radiographers were noted to feel like 'isolated workers' who saw little prospect of career improvement. The success of extended radiographic roles depends on a base of clinical competency, with a foundation of high-level education and training that is responsive to clinical realities.

5.4.2 COMPETENCY MANAGEMENT

Competency management (CM) is regarded as an important concept in the maintenance of transferable human capital output (Janev and Vraneš, 2011). The concept is concerned with human capital capabilities in relation to focused or determined competency standards aligned to prescribed levels of professional practice. The application of knowledge, skills and approach for specified job requirements can be promoted to standardised professional or departmental consistency (Commonwealth of Australia, 2009). Competency Management may be categorised as:

(a) individual expert competencies – specific, identifiable, definable and measurable knowledge, skills, abilities and/or other deployment-related characteristics such as attitude, behaviour, physical ability necessary for the performance of an activity within a specific job context, and

(b) organisational core competencies – as aggregates of capabilities for sustainable value and broad applicability in an organisation.

Competency Management calls for an underlying analysis of skills gaps to guide the continuous promotion of necessary skills, as a general improvement undertaking seeking to support the professional relevance of human capital. It comprises a range of practices, used within an organisation or department, to promote the dissemination of valuable practical experiences and insights, for possible adoption or recognition among team members. Such experiences or insights comprise competencies either embodied in individuals or forming part of distinctive transferable professional practice. By way of illustration, physicians in this study *[Table 25, Chapter 4]* indicated that radiography staff should participate in clinical presentations on radio-diagnostic investigations and findings to promote the dissemination of valuable practical experiences and to foster interaction with physicians. Such responsibilities were seen to fall within the considered outputs from the extension of radiographic roles and may be seen as a means of disseminating radiographic competencies to facilitate learning and exchange of views amongst trainees, peers, and superiors within the radiography profession and/or among other healthcare professions.

As described in earlier chapters, human capital may be likened to fixed capital (Bowles and Gintis, 1975; Aghion and Howitt, 2007), which comprises interchangeable assets, such as equipment, buildings and land, based on a determined value. However, some aspects of human capital, in the form of competencies and their underlying knowledge, skills, experience and embodying attributes, are not so easily quantified and are less readily interchangeable or transferable. Michael Polanyi (1966: 4) maintains, with reference to tacit knowledge, that as human beings "we can know more than we can tell", thereby justifying the value of informal learning co-existing with formal learning (Smith, 2003).

Where feasible, the role of mentorship or internship to augment practical training provides trainees with an opportunity to engage in additional learning opportunities with experienced practitioners. The physicians recognised CM being applied in the clinical mentorship of radiographers by radiologists or other appropriately competent practitioners to be valuable. However, in order for radiographers to engage in effective CPD, incorporating CM, by which is included a number of forms of self-directed learning and mentorship, a profoundly rich educational base would be required to facilitate the development of an extended range of competencies in a range of imaging modalities. In the piloted radiographic training which involved radiographers who had a diploma-level radiography qualification, radiologists, in their capacity as trainers, identified that trainees had more strength [in terms of knowledge and skills] in general radiology than in the newer modalities, such as CT or radionuclide imaging. The trainee radiographers felt that the development of extended skills would require funded internship programmes to fortify the process to desirable scope of competencies.

In order for radiographers to be able to take up and sustain extended roles as frontline radiographic practitioners, a fundamental radiographic education and training would be necessary. Subsequent training in extended roles would aim at promoting the required clinical competencies. The physicians who participated in this study conceived that radiographers would need an appropriate training that would enable them to competently produce diagnostic reports. They further proposed that it would be useful if there were a deliberate programme that allowed radiographers to be attached to a hospital and to train under a radiologist (so that they could learn how to effect radiological reporting and specialised investigations) before they were posted to locations in which they would be expected to perform the complete range of frontline radiological activities. The extended roles of diagnostic reporting, contrast-aided examinations, detailed ultrasonography and CT were seen to be some of the most urgent clinical areas for extended radiographic practice.

Such a responsibility, as a frontline radiographer with extended radiographic practice, would also imply competent professional interaction with physicians and radiologists, expressed among potential strengths of the proposed radiographers' training programme. It was proposed that radiologists would have scheduled provincial clinical visits to attend

to specialised investigations that necessitated specific radiological competencies. While such visits, or clinical collaboration, would primarily serve the patients, the radiographers would be afforded an opportunity to systematically extend their learning and upgrade their competencies in the interaction process. Such an arrangement would be envisaged to promote problem-solving interaction through the flow of communication within radiology departments from physicians to frontline radiographers to radiologists and vice versa.

Benziger (2008) supports the notion that competencies are sought when the learner recognises his/her own incompetency within a desirable job functional area. Notwithstanding such recognition, however, it was felt by radiographers that their views were not appropriately represented as the evaluation of their role functions were conducted by representatives of other professions in the Province. Radiographers' competency-based output may be viewed as an important source of job satisfaction and stress reduction (Graham *et al*., 1999) when associated with positive feedback from clients and/or other healthcare practitioners.

The acquisition of competencies in extended radiographic roles was seen as a long awaited progressive step in radiographic practice among the radiographers. Whilst the levels of radiography education and training were seen to be unclear amongst healthcare managers and clinicians, they were unequivocal in their emphasis of the need for radiographers to acquire specialised radiographic clinical competencies. This recognition of need for clinical training did not preclude simultaneous need for formal education at institutions of higher learning to underpin clinical-based training under appropriate mentorship.

Competency Management is also seen to extend beyond individual capabilities into the management of organisational core competencies (Janev and Vraneš, 2011) as aggregates of capabilities having sustainable value and broad applicability within an organisation. Within this view, CM would call for the underlying analysis of skills gaps to guide continuous promotion of necessary unitary skills within hospital radiology departments or the provincial radiological service provision to ensure that competencies are not confined to individuals, but rather are intrinsic to whole unit.

With an appropriate number of radiographers having advanced clinical competencies, it would be possible to ensure competent radiological services within the province. A desire for outreach radiological services was expressed by participants as one of the preferred remedial actions to improving the radiological services, with specific reference to the scheduling of clinical visits by radiologists to a designated referral radiology department within the province *[see Figure 2, Chapter 4; Table 25, Chapter 4]*. Such a service was supported by the radiologists, some healthcare managers and physicians, who had had comparable personal experience of the proposed model within the context of other healthcare specialities. Similarly, the provision of outreach healthcare services, in Zambia's Sixth National Development Plan, is among the key strategies for equitable access of healthcare services (Ministry of Finance and National Planning, 2011). The mechanism of intra-provincial management of competencies is already operational (Ministry of Health, 2009b) and would be understood to support the advancement of optimal accessibility of extended radiographic roles within the province as, minimally, the four hospitals, Yeta, Sichili, Mwandi and Senanga were cited for receiving technical support during this study.

5.4.3 WORKFORCE PLANNING AND RECRUITMENT

Workforce planning and recruitment could be viewed as a part of human capital processes that is linked to the growth and value of an organisation or department (Thomas, Cheese and Benton, 2003). As such, it exists as the Ministry of Health (2011) strategy to increase the number of trained health workers available to the healthcare sector

Insufficiency or unavailability of the required health human capital remains a major challenge in the Zambian radiological services. This insufficiency is particularly heightened in rural areas of the country. The appropriate recruitment, development and placement of human capital would serve as a catalyst for the improvement of radiological technology and service as elements of improved healthcare delivery. Physicians recognised the importance of having appropriately trained radiographers in ensuring appropriate supply of radiological products, such a contrast media and radiological technology. Such radiographers would also understand the practice of specific radiological

investigations, additional to their areas of specialisation, and be able to initiate strategic radiological plans.

From the perspective of the Resident Doctors Association of Zambia (RDAZ) regarding scarcity of personnel in the Zambian healthcare sector, with specific reference to the radiology departments, it was felt that shortages were so much that it became difficult for the clients to appreciate all the hard work or input of the understaffed health workers. Relevant training institutions were, therefore, called upon to address this challenge through relevant training in terms of both quality and quantity of required personnel to reduce on the referrals (Chakwe, 2011). Evelyn Hone College, as the only training institution for radiographers at the time of this study, had by 2011 graduated 450 radiographers since its first year of graduation in 1973 (Evelyn Hone College, 2008). It was noted that in the same year (2011), only 226 radiographers were employed in the public sector by the Ministry of Health.

The lack of an updated hierarchical radiographic career structure was seen as an impediment to an effective planning and recruitment process of radiography personnel. This discrepancy was also seen to be in conflict with the reality of the radiographic profession which is characterised by advances towards an increasingly multimodality milieu. The possibly positive impact of the development of high levels of education, training and competency associated with the evolution of radiographic practice would be rendered futile if no strategically competency-based hierarchical structure were to be developed. The scope provided by a clear radiographic career pathway would also be critical to the fostering of continuing professional development. These considerations were indicated by clinicians who recognised that the creation of a hierarchy would increase workforce productivity and motivate radiographers to develop towards ever-increasing levels of responsibility and leadership. The generation of such a hierarchy would, of necessity, require benchmarking of competencies against comparable international standards in radiographic practice to guide licensing, under Health Professions Act 24, of competencies acquired from either local or outside of Zambia training (Republic of Zambia, 2009: 360).

The call for a hierarchical professional structure was confirmed by radiographers who saw this structure as a means of 'filling the gaps' and promoting professionalism and escalating the advancement of radiographic roles above those of routine radiographic practice. In keeping with their view, radiographers indicated that they would be motivated to pursue advanced professional qualifications and competencies where such attainments were to be linked to the upgrading of their professional ranks.

Patients, in turn, saw the low numbers of radiographers in clinical practice to be disadvantageous to the efficient delivery of radiological service and called for an increased radiological workforce having an increased number of skills *[see Table 14, Chapter 4]*. At the time of evaluating the clinical outcome of the training programme, the challenges presented based on the workforce shortages were reflected as; long queues, limited numbers of radiographers attending to patients, a shortage of x-ray machines (associated with shortage of personnel for more machines) and limited capacity for diagnostic radiographic interpretations. It was noted that while the extension of radiographic roles added value to the radiological service provision, it could equally slow down the rate of service output in those situations in which additional radiographers were not available to attend to routine imaging, emergencies and specialised procedures. Among the stated preferences for remedial action was the provision of an increased number of radiographers from several radiography schools *[see Figure 2, Chapter 4]*. These challenges and recommendations suggested, also, the need for an appropriately and planned number of imaging rooms proportional to the increased number of imaging machines and radiographers.

The desirable multimodality radiology department involving specialisations such as CT, diagnostic ultrasound, diagnostic radiographic reporting and service management, would require a supportive workforce plan for radiographers. Such a plan would necessitate strategically planned activities with timeframes for both long and short training programmes as a component of an investment and retention plan, and would further serve to encourage prospective radiographers who may otherwise find the profession less appealing for a career. The absence of radiographers in some hospitals was partly linked to unfavourable geographical locations and transport systems, leading to radiographers being reluctant to work in rural areas despite the incentive of a 'rural hardship' allowance.

5.4.4 ROLE EXTENSION AND LICENSING

There has been a notable amount of research into radiographic role extension worldwide. The bulk of this work has been in reference to developed countries having radiology departments that already enjoyed the services of radiologists (Price, 2006; Rudd, 2003; Williams, 2009; Henwood, 2003). This study investigates the extension of radiographic roles in disadvantaged radiology departments that are without radiologists, with specific reference to the Zambian context. Radiologists themselves have had a significant role in spearheading the exploration of extended roles for radiographers. Witcombe and Radford (1986), respectively a radiologist and a radiographer, jointly conducted a survey in which they found that in the UK over 70 percent of obstetric ultrasonography examinations with reports were conducted by radiographers. Within the Zambian context, in which there are three radiologists in service of a population of thirteen million people (Central Statistical Office, 2011) it was contended that a mechanism had to be found to spearhead the extension of radiographic roles in collaboration with these radiologists.

The reported successes of extended roles in radiography today are largely dependent on advanced university education and training in radiography, in addition to radiological technology. This level of education and training is in support of requisite educational background for extending radiographic competencies. In this study, physicians noted that radiographers who had undergone and exploited advanced radiographic education and training showed positive changes in the way they interpreted ultrasound investigations, which could similarly be exploited to back successful diagnostic radiographic interpretations and reporting. Human capital development, in this case involving extended roles, can be seen to be associated with an improvement in overall service quality and productivity (Griliches, 1997) backed by specifically increased competency levels. Although there are several identified areas for radiographic role extension, this study applied only diagnostic reporting of chest x-ray imaging being the most common gap for remedial intervention, and could be administered within the study, with prospects of being extended to other areas of imaging. Diagnostic reporting, itself, is common for all diagnostic radiological investigations to an extent that planning new areas of imaging, or new imaging technology, would require consideration of available competencies in

diagnostic reporting for cost-effectiveness of radiological service investment. A diagnostic report is recognised as key method of conveying clinical response from the radiology department to the clinicians' requests (Grieve, Plumb and Khan, 2010) without which the radiological services would, technically, be incomplete as physicians also noted in this study. The learning modules in the radiographers' training programme (DP3R), inevitably, involved commonly underlying themes or elements for application to a wider range of imaging modalities *[see Table 10, Chapter 3]* beyond chest x-ray imaging. It is envisaged that what may today - or since the 1980s - be regarded as extended roles, would as well be assimilated as part of the radiographers' areas of competencies albeit specialisations.

According to the views of the World Health Organisation (WHO) (2007: 10), competent health practitioners are required to deliver healthcare that is 'responsive to the needs, preferences and expectations of people accessing health services'. Arguably the most effective and appropriate strategy towards achieving this goal would be the appropriate education and training of a range of health practitioners, based upon the identification of the necessary core competencies. In this study, physicians were seen to embrace the notion of radiographic role extension around competencies that were identified as lacking within radiology departments, since radiographers were understood to already possess some of the requisite basic skills.

From the perspective of radiographers themselves the solution was suggested to also include the need for the HPCZ to open a register in which trained extended-practice radiographers would be licensed for higher-level practice and authorised to conduct designated specialised procedures or investigations. The parallel example was provided of Clinical Officers who are able to access a medical licentiate programme which enables them to perform minor surgical procedures including Caesarean section. Such an approach was seen to enable efficient and optimal radiological service delivery, taking cognisance of the legalities and ethics of service access and safe management of patients. Some patients in Phase Four of the study encouraged hospitals to do their extended work 'in all areas of radiology' for the benefit of patients. The radiographers' training outcome, although in a restricted area, was viewed as positive and patients presumed that the positive change they observed in this restricted area would 'roll out' to other areas of the service. By virtue of the 'action research' design, its 'circular' nature up to evaluation allowed for such positive

feedback to be 'fed' into the evolution of ever more extensive 'roll outs' – in support of the patients' expectations.

In asserting the commitment of the WHO to a 'people-centred health care', Omi (2007: 1) counselled member states to ensure the practicality of remedial healthcare service interventions targeted towards improving health outcomes and increasing degrees of well-being within population. Improved well-being within communities may be associated with improved economic advantages amongst patients, as was discussed in an earlier section of this Chapter relating to issues of poverty reduction.

In support of patients' expectations that the improved quality of service would be extended into areas outside of the study, clinicians, at various stages of the study, were understood to call for the development of radiographic competencies in areas over and above those of radiographic reporting. The physicians maintained this call for a diverse extension of training that included diagnostic reporting, specialised examinations and advanced ultrasound. Notably, diagnostic reporting would still be part of complete specialised x-ray examinations and advanced ultrasound services including echocardiography.

It is abundantly evident that curricular developments at undergraduate level have been impacted upon by new radiological technologies and their consequential developments in practice (Price, 2006; Goldsmith, 2011). In step with these changes, it would follow that those institutions that accredit the radiographers would accordingly deem it appropriate to reorient their registration criteria in accordance with the contemporary trends within the profession and changing service needs. Collaboration among the Ministry of Health, training institutions, regulatory or licensing bodies and radiographers' professional body or bodies would be seen as vital in this quest.

Support for the development of sustainable extended radiographic clinical competencies within Zambian radiographic practice would be understood to fall within the provision for innovation within healthcare professions, as contained in sections 7(a) and 7(b) of the Health Professions Act 24 (Republic of Zambia, 2009: 359) which grants the Minister (of Health) the power to endorse both the qualifications for registration and the scope of practice of health practitioners registered under the Act. This provision would be sought in

addressing the participants' views to achieve appropriate education and training for the required radiographers' recognised extended competencies and associated competency-based hierarchy of clinical responsibilities.

Reviewing the scope of practice, through the reinforcement of existing professional roles and the reorientation or relocation of other healthcare competencies has been hailed as one of the most effective strategies towards addressing human capital challenges in healthcare (Krupp and Madhivanan, 2009). Whilst the scope of radiographic education has been adapting to suit the realities of current radiographic practice, the revision of licensing criteria would help to regularise such developments. Frontline radiographers who have been trained into extended roles would have successfully acquired a fundamental radiographic education and training prior to enrolling for postgraduate training in extended roles. In contrast to the existing unlicensed *ad hoc* clinical arrangements for extended radiographic practice (Price, 2006; Kawooya, 2008), appropriately licensed extended-role radiographers would have prospects of formally advancing their appraised competencies, for the benefit of the nation or communities.

According to the Zambian Sixth National Development Plan on health (Ministry of Finance and National Planning, 2011: 17), "a healthy population is critical to improved production and productivity. Government will continue investing in the health sector in order to bring health care as close to the people as possible and also to ensure sustainability of the nation's human capital base required for sustainable economic growth". The proposed accreditation of extended-role radiographers would also afford the HPCZ an opportunity to safeguard the public interest through the provision of radiological services that are regulated and equitably provided throughout the country. As the licensing institution, the HPCZ would be able to continually monitor and evaluate the practice, including CPD, in collaboration with the professional body, the RSZ.

The researcher takes cognisance of the functions of the HPCZ which include (a) maintaining appropriate practice standards among health practitioners that are consistent with the principle of self-regulation and the promotion of high standards of public health; (b) developing, promoting, maintaining and improving appropriate standards of qualification in the health professions; (c) promoting the integrity, and enhancing the

status, of the health profession including the declaration of any particular health practice to be undesirable for all, or a particular category, of health practitioners; (d) representing, coordinating and developing the health profession and promoting its interests; and (e) developing, promoting and enforcing internationally comparable practice standards (Republic of Zambia, 2009: 356). The registration of extended radiographic practice within the HPCZ would be argued to be an essential step towards regularising the practice and optimised radiological service delivery.

CHAPTER 6
SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents the summary, conclusion and recommendations arising from this study. A Frontline Radiographic Human Capital Development (FRHCD) conceptual framework is recommended as a guideline towards improving accessibility and the quality of radiological services in rural Zambian Western Province without the services of a radiologist. In addition, recommendations for further research, and radiography education and practice are made. Lastly, the Chapter ends with a presentation of study limitations

6.1 SUMMARY

The persistent shortage of radiologists in Zambia has made equitable access to an optimum radiological service unattainable within the current Zambian radiological health service delivery system. This is at a time in which equity of distribution of a cost-effective and quality healthcare service as close to the community as possible has been earmarked as a core focus of the Zambian National Health Strategic Plan (Ministry of Health, 2005), and a component of Zambia's Sixth National Development Plan (Ministry of Finance and National Planning, 2011). With a number of radiologists being as low as three, in service of a population of thirteen million people (Central Statistical Office, 2011) in the Zambian public health sector, the deficit is gargantuan. Such a deficit seriously impedes the possibility of an optimum radiological services ever being provided, unless precise interventions are methodically and strategically implemented.

The purpose of the study was to develop sustainable human capital developmental guidelines that embraced the need for reliable advanced radiographic practice in the Zambian context. Special focus in the study has been placed on strategies towards optimal radiological services among those hospitals in which no radiologist was available. The objectives of the study were to (a) analyse the existing radiographic services and/or practices in rural Zambian hospitals that are without radiologists; (b) examine the views of radiographers, physicians, and patients in those hospitals without radiologists regarding the adequacy of the radiological service provision; (c) determine the desirable competencies for frontline radiographers in comprehensive radiological service delivery, as well as the

benefits that such competencies may bring to the community and the health service facilities; (d) analyse the managements' expectations regarding frontline radiographers' capabilities in rendering comprehensive radiological services in healthcare settings without radiologists; (e) formulate, implement, and evaluate a training programme for radiographers towards comprehensive radiological service provision, with specific references to client (physician and patient) satisfaction and radiographic competencies, and (f) develop a framework for human capital development for frontline radiographers who render comprehensive radiological services.

An Action Research design that involved multidisciplinary participation in all four phases was implemented. Participants, in the various phases, included clinicians, patients, radiographers, radiography assistants, radiologists, healthcare managers, and lecturers in radiography. A modified version of the AHCDF (Thomas, Cheese, and Benton, 2003) was used to guide the study. Considerations were made at the diagnosing stage (Phase 1) in order to determine factors that contributed to the current status of radiological services in Zambia. This information was used to formulate a remedial action as Phase 2. The remedial training programme, Diagnostic Pattern Recognition and Reporting for Radiographers (DP3R), involved training in diagnostic reporting. This programme was piloted in Phase 3, and the training outcome was evaluated as Phase 4 within the clinical environment in terms of its relationship to Phase 1 to determine the way forward.

6.1.1 The Radiological Service Result

The radiological service result was concerned with determining the ultimate performance of the radiological service in terms of (a) accessibility of the radiological services; (b) the associated costs to patients; and (c) the associated costs to the healthcare facilities themselves. The study indicated that the limitations within the radiological service provision, arising from inadequate human capabilities and technological inadequacies, lay behind the seemingly avoidable need for radiological referrals. When patients were referred to third referral hospitals in Lusaka, the distance between the district access point and the referral site sometimes exceeded 600 kilometres. Such referrals were associated with both excessive costs incurred by the referred patients and/or their families, and costs to the referring hospitals in terms of transportation and lodging costs.

6.1.2 The Radiological Key Performance Drivers

The radiological key performance drivers reflected the work environment itself and the mechanisms that would steer desirable radiological service delivery, and were based upon (a) the quality of service delivery; (b) innovation and productivity within the work environment; and (c) perceived states of client satisfaction. These three factors are interrelated and point, ultimately, to the quality of the service provision and overall state of satisfaction amongst clients. Human capital, in terms of its baseline capacity and its capacity for development, however, remains the agent of quality service delivery.

Participants were noted to conceive the quality of the radiological service provision in terms of the capacity for the required investigations to be achieved in a requisite amount of time. The inabilities of the existing provision to achieve the desirable operational outcomes were able to be associated with unavailable competencies. In turn, the pursuit of the availability of competencies would serve to act as a catalyst towards acquisition of the radiological machinery and technologies to match those competencies. Furthermore, it was identified that enabling policies that support innovative radiographic practice, and are in step with the operational requirements of the clinical radiographic setting would be a necessary factor in radiological transformation. Clients of the service expressed satisfaction with the piloted provision of diagnostic reports by radiographers. However, there was also an additional call for a more widespread extension of roles, such as would include contrast-media aided examinations and echocardiography.

6.1.3 Human Capital Capabilities

The investigation of human capital capabilities focused on the determination of the most immediate and noticeable service-related staff capabilities within radiology departments. These capabilities included (a) radiographic technical skills; (b) adaptability to work demands; and (c) employee engagement, including intellectual, emotional, and competency orientation, as well as application of suitable radiological technology. The study revealed that the radiographers were strongly opposed to the present lack of opportunities to upgrade their radiographic qualifications and competencies.

6.1.4 Human Capital Processes

The performance drivers and human capital capabilities described above are intrinsically linked to human capital processes, and consequently the quality of the service as a performance outcome is a function of a delicate interplay of these inter-related factors. Human capital processes incorporate those activities and/or policies that are aligned to the investment in human beings towards the development of desirable capabilities for worthwhile service outcomes. Such processes may include career development, education and training, competency management, workforce planning and recruitment, role extension and licensing. Radiographic human capital, in this specific context, therefore was seen to embrace the knowledge, skills, competencies and attributes embodied in individuals. Human capital *per se* is, therefore, vital to all levels and sectors of radiographic practice.

The proposed remedial action in terms of the radiological service gaps arising from the lack of radiologists, and the subject of this study, was seen to reside principally in the development and extension of the clinical radiographic roles. To this end, there was corroboration of outcome in terms of the evaluation of the training programme itself, and the evaluation of the consequent clinical application through the provision of diagnostic reports. Radiographic human capital development in tandem with radiological technology and administrative support were seen as a necessary investment towards ensuring the provision of equitable access to quality radiological services in areas with limited access to radiologists' services.

6.2 CONCLUSION

This study has shown that the development of advanced competencies or extended roles amongst radiographers could play a significant role towards the reduction of persistent radiological service gaps in the Zambia context. Importantly, it was reported that the current meagre staffing levels within radiology departments in the rural Western province do not allow for regular staff development participation by the radiographers working in these units. This disparity, coupled with a lack of radiologists as well as an inadequate basic level of education for radiographers, has led to compromised radiographic

competencies and/or radiological service delivery in such rural areas. Hence, there would appear to be an urgent need for revision of the education and training offered to radiographers, as well as review of those policies that relate to licensing of practice and use of related radiological equipment and infrastructural provisions to sustain rural healthcare settings.

6.3 RECOMMENDATIONS

The World Health Organization (2007) recommends the provision of competent practitioners for; a healthcare service that is responsive to the needs, preferences and expectations of the people seeking radiological services. The results of this study, albeit from a pilot eight-week education and training programme suggest that investment in extending radiographers' competencies and associated technological and administrative support would go a long way towards alleviating the challenges associated with the absence of radiologists in rural Zambia.

The recommendations, below, seek to afford Zambian citizens the greatest possible sustainable benefit from the identified advances in radiographic practice. Such an innovation is proposed to be within the capacities of achievable radiographic education and training, radiological technology, and administrative reorientation. Through the proposed remedial interventions, Zambia's persistent challenges to provide equitable and optimal radiological service within the affordable reach of communities, is envisaged to be surmountable. The researcher proposes the following recommendations towards addressing the prevailing radiological service gaps and inequities of provision:

6.3.1 The Recommended Frontline Radiographic Human Capital Development Conceptual Framework

Arising from the results of the study, a Frontline Radiographic Human Capital Development (FRHCD) conceptual framework was developed. This framework is recommended as a guideline for further work aimed at improving accessibility and quality of radiological services in rural Zambian Western Province without services of a radiologist.

Maxwell (2005: 33) broadly defines a conceptual framework as a 'system of concepts, assumptions, expectations, beliefs, and theories that supports and informs [the] research'. In the development of a conceptual framework the researcher is compelled to be explicit in his/her thoughts about the purpose of the study and selective of the key theoretical features of identified relationships. There are different types of conceptual framework based on integrative diagrams and/or concept maps (Strauss, 1987; Novak and Cañas, 2008).

Jabareen (2009) contends that conceptual frameworks do not depict predictive causal relationships, but rather are a descriptive explanation of the phenomenon under study. He defines a conceptual framework as a 'network … of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena' (Jabareen, 2009: 51). Robson (2011), in turn, supports the assertion made by Miles and Huberman (1994) that a theory about what is going on, of what is happening and why, is sometimes referred to as conceptual framework. A conceptual framework explains, either in graphic or narrative form, the main aspects of the phenomenon under study. These aspects would include the key factors, constructs or variables, and the presumed relationships between them. A conceptual framework proposes the researcher's position on the problem, in terms of the relationships existing between different theoretical constructs or concepts from the study, as a means of operationalising the theory. As such, the goal of linking key concepts from the study should demonstrate high levels of 'internal consistency' within the conceptual framework (Zeidler, 2009; Robson, 2011). The researcher-devised FRHCD conceptual framework is depicted in Figure 4, overleaf, based on the sixth objective (f) of the study *[see section 1.4]* and analysed aspects of the study leading to tangible or determinable service outcomes. Coupled with the conceptualized research methodology and results, the FRHCD conceptual framework is inclined to the modified AHCDF *[see Table 6]* that guided this study outlined in summary *[see section 6.1]* above.

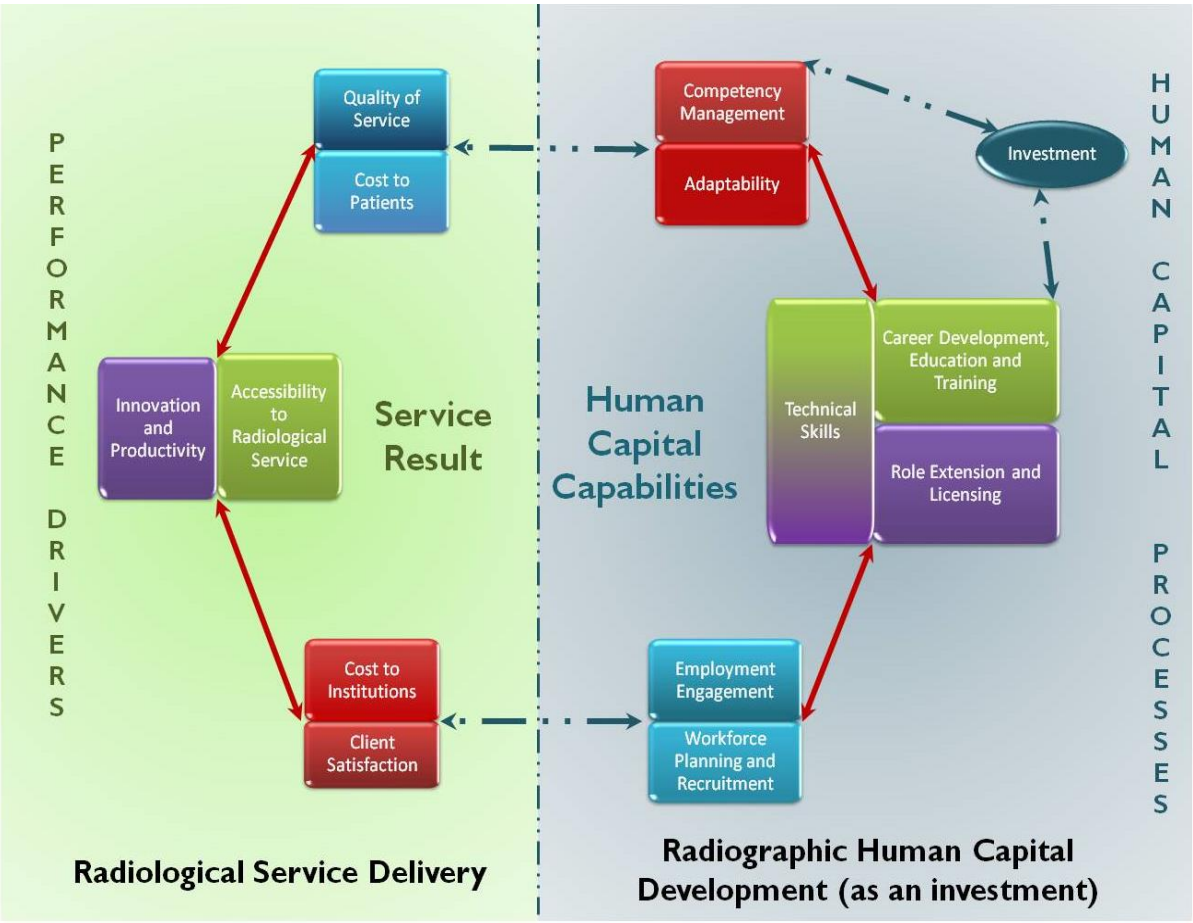

Figure 4: Frontline Radiographic Human Capital Development Conceptual Framework

6.3.1.1 Goals of the FRHCD Conceptual Framework

The purpose of the proposed conceptual framework is to provide a representation of the subject matter of this study within a real world context. The FRHCD conceptual framework, therefore, serves to form a theoretical and practical basis of explanation of the centrality of radiographic human capital development in the context of radiological service delivery in rural areas without the services of radiologists. The substantive concepts of the framework are seen to represent a multifaceted system that could be integrated into the planning and/or evaluation of the quality of a radiological service provision. Fundamentally, investing in frontline radiographers' career development, education, and training is seen as influential to determining an appropriately matching technological equipment and infrastructure for quality service result.

6.3.1.2 Definitions and Relational Statements of the Substantive Concepts of the FRHCD

Chinn and Kramer (2004: 61) define concepts as 'complex mental formulations of experience'. The three sources of experience may be considered in terms of (a) words or symbolic labels; (b) an actual object, property or event; and (c) feelings, values or attitudes associated with words, objects, symbols, or events. A concept may be seen as an image or symbolic representation of an abstract idea.

Within the context of the FRHCD conceptual framework, radiological service delivery and human capital, as an investment, are the major concepts upon which the framework is built. The performance or service delivery of a rural radiology department and the capabilities of radiographers are linked to the status of the radiology department and radiological service provision. The basic premise on which the conceptual framework is based is that optimal radiological service provision within rural healthcare settings, in which the services of radiologists are not enjoyed, requires supportive policies, administrative design and a supportive level of radiographic education, in order to provide the greatest benefit within available human and material resources. Relationships between and among concepts are described below.

6.3.1.3 Radiological Service Delivery

Radiological service delivery, as a concept, may be seen to encompass the service result and key performance drivers. The concept is further related to a number of sub-concepts, which are described below:

a. **Radiological Service Result** refers to the ultimate outcome of radiological service provision, with specific reference to the accessibility of radiological services, the cost of acquiring radiological services incurred by patients, and the cost of offering radiological services incurred by healthcare facilities. The accessibility of radiological services, in turn, includes the affordability of quality radiological services and the availability of appropriate technology and competencies. The

FRHCD sees the service result as a function of the available radiographic human capital and related radiological equipment and machinery. The high cost of radiological services to patients and healthcare facilities through referrals, could be reduced by improved radiological service availability at local healthcare facilities. Radiographic or radiological service delivery is dependent on another sub-concept, key performance drivers with several enabling factors, as shown below:

b. Radiological Key Performance Drivers are critical factors that determine whether an optimal service delivery is achieved, and reflect the work environment and mechanisms that steer radiological service delivery towards the desired outcomes, based on quality of service delivery, innovation and productivity, and client satisfaction. Such drivers would include:

i. The quality of radiological service delivery evidenced by the status of the radiological workforce, such as the number of radiographers and their radiographic competencies;

ii. Innovations/productivity in the variety of approved services/examinations that incorporate advanced and modern digital radiological equipment.

iii. Client satisfaction, from the perspective of patients and clinicians, in the optimisation of the available radiological material/technology and human competencies in pursuit of a comprehensive service provision.

6.3.1.4 Radiographic Human Capital Development (as an investment)

Human capital capabilities and human capital processes are the sub-concepts of the radiographic human capital development concept. Radiographic human capital development is seen as one of central concepts of the FRHCD conceptual framework. The basic premise of the conceptual framework is that radiographic human capital development is an investment and that it is highly dependent on the relationships between and among the concepts that form the conceptual framework's building blocks *viz.* radiographic human capital capabilities and radiographic human capital processes. The proposed links between, and among, these sub-concepts are described below:

a. **Human Capital Capabilities** are the most immediate and noticeable service-related staff capabilities, such as radiographic technical skills, adaptability to work demands and employee engagement *vis-à-vis* their intellectual, emotional and competency orientation or diligence in the application of suitable radiological technology. These capabilities would include the components defined below:

   i. Radiographic technical skills, denoting the scope of radiographers to aid radiological service delivery. These skills, such as radiographic pattern recognition and reporting, would need to be supported by appropriate training programmes;

   ii. Adaptability to work demands, which entails the maintenance of competencies in the face of changing work demands. The change in radiological need beyond the scope of prevailing radiographic practice would be aided by appropriate education and training;

   iii. Employee engagement, in terms of the intellectual, emotional, and competency orientation or diligence in the application of suitable radiological technology, as this is associated with departmental output or productivity (Harter, Schmidt, and Hayes, 2002). Employee engagement by radiographers would be jeopardised by unmet job expectations. Within the context of this study, a lack of opportunities for, or support of, the attainment of advanced competencies through formal education and training was seen to have a negative impact on employee engagement. The radiographers' levels of competencies were seen to influence the choice and/or application of appropriate radiological technologies, with consequent impact on the quality of radiological service delivery. Departmental leadership is seen to be cardinally important in developing commitment and responsibility amongst radiographers and to promote and/or maintain professional governance. The quality of organisational or departmental management influences employee engagement (Saks, 2006).

b. **Human Capital Processes** refer to the activities and/or policies that are aligned to the investment in human beings towards the development of desirable capabilities for worthwhile service outcomes. These processes include career development, education and training, competency management, workforce planning and recruitment, role extension and licensing, as described below:

i. Career development, education and training are linked in terms of the translation of education and training into valuable competencies within a defined career path. This concept is related to the scope of practice at a particular recognised level of education and training, as well as to the scope of available matching equipment and/or technology for practice and training.

ii. Competency management refers to the dissemination of valuable practical experiences and insights, for possible adoption or recognition among peers and/or other healthcare team members. The role of mentorship and/or internship is applicable within the concept of competency management. Information Communication Technology (ICT), as in the form of teleradiology, is seen to be relevant in terms of consultancy, healthcare referral requisite image and feedback, and CPD.

iii. Workforce planning and recruitment calls for the identification of various levels of scope of practice within radiography. Particular attention would be placed upon recognizing radiographic specialities and the availability of radiographic capabilities required for efficient delivery of radiological services. A competency-based hierarchical management of radiographic practice, which delineates the levels of the profession at which a diverse range of innovations would be appropriately guided, is fundamental to radiographic workforce planning and recruitment.

iv. Role extension and licensing calls for a continued re-evaluation of innovations within radiographic practice. The evolution of radiographers' professional practice would require parallel innovative and positive adjustments to the related licensing mechanisms and processes, in the interest of improved service delivery to communities. In this regard, the investment in frontline radiographic innovations reinforces the role of extended radiographic practice in Zambia, particularly within underprivileged and rural communities.

6.3.1.5 Assumptions of the Conceptual Framework

Some aspects of the FRHCD framework phenomenon were assumed, and fell outside of the researcher's intended areas for investigation. It was assumed that rural Zambia would for the immediate foreseeable future be serviced by an inadequate number of radiologists.

With a total of only three radiologists, there has been no notable evidence of growth in the number of radiologist in Zambia from the time the radiological services were first introduced in Zambia in the 1930s to the present times (D'Arcey-Irvine, 1970; Munsanje, 1996). Furthermore, it was assumed that the increasing demand for radiological services and the notable growth of radiological technology worldwide would continue. It was also assumed that advances in radiographic practice would continue, at the global level, but that there would be no benefit to local communities in the absence of interventions such as advocated within the FRHCD conceptual framework.

6.3.2 Radiographic Education and Training

The Zambian government should, in collaboration with the Radiological Society of Zambia (RSZ), look into commencing and/or strengthening the degree programmes in radiography, based on educational curricula that are responsive to the identified challenges and addressing possible solutions. The preparation for such education and training ought, further, to take into account the provision of adequate equipment and space for student-centred learning to promote competencies. There is need to investment more intensively in fundamental programmes, such as initial degree programmes, so that short courses may serve, merely, to supplement this base. It has been seen to be costly for radiographers to continuously need to seek external initial degree programmes, in most cases at their own cost. An initial degree programme in radiography would be seen to be the underpinning bedrock for extended roles at postgraduate level.

6.3.3 Postgraduate Diploma in Advanced Radiography Practice

Within the span of this study, the Diagnostic Pattern Recognition and Reporting for Radiographers (DP3R) training programme was designed and piloted for two months *[see Table 10 and Table 11 in Chapter 3]*. In view of its positive application and clinical outcome, this programme should be upgraded to a Diagnostic Practice, Pattern Recognition and Reporting for Radiographers (DPP3R) training programme that incorporates a wider range of extended clinical roles. The programme should be designed as a competency-based postgraduate programme with internship, be of longer duration, and enjoy the participation of both public and private hospitals. The actual duration of the programme

would need to be determined as a function of the actual curriculum content and design, and preferably be offered by block-release to support work whilst learning. Consequently, the radiographers that participated in the training programme should have their learning recognized and supported by the Government and/or other stakeholders to progress towards a fully fledged DPP3R programme with a wider and more detailed scope. At least two block-release classes with alternating residential tuition and work-based training blocks at different levels, and incorporating ICT mode of learning, are recommended to enhance accessibility of such training among radiographers whilst keeping the radiology departments operational.

6.3.4 Radiographic Levels of Practice and Career Pathway

In order to advance the radiography profession for the benefit of the country, whilst keeping abreast with both local and global motivating realities, the necessary levels of education and clinical competencies ought to be recognised by regulatory bodies, Government, and all employers. With regard to developed radiology departments or countries, The College of Radiographers (2005) and Price (2006) recognise three licensable hierarchical levels for radiographers. These clinical competency-based levels, in ascending seniority, are comparable to (a) a radiographer for general radiographic practice, (b) an advanced practitioner radiographer, having advanced clinical competencies in specified areas, and (c) a consultant radiographer, for expert clinical leadership in specified areas (Snaith, B. 2011; EFRS, 2011). Within the Zambian context, radiographers should have competency-based strata for licensing and recruitment, incorporating general radiography, as well as specialised radiographic practice in those situations in which extended role training and practice are built upon an initial radiographic degree level education and training.

Towards proactive planning of recruitment of radiographers, Zambia would need to determine the competency-based tiers for radiographic recruitment, in tandem with the relevant updates to the licensing criteria to be applied by the Health Professions Council of Zambia (HPCZ). It is envisaged that such a hierarchical progression structure would promote engagement by radiographers in the development of competent skills, which Graham *et al.* (1999) recommend to be an important source of job satisfaction and stress

reduction. Employee engagement, job satisfaction and stress reduction are seen to be among the ideal drivers of professionalism and motivation through self-directed CPD. The proposed hierarchical structure would also serve to address such 'barriers to technological and organisational innovation' as ill-defined leadership, as elucidated by Boonstra and Vink (1996: 351) and also reported in this study based on practitioners' views regarding need for different levels of professional interaction and leadership.

6.3.5 Licensing of Radiographers

The extended radiographic roles should be recognised to be among the existing radiographic roles within the current era. Radiographers' functions and responsibilities have changed, particularly over the last three decades – from the 1980s. The associated innovations and/or advances in radiological technology, imaging methods and foundational radiographic education are well recognised. Defined radiographic levels of practice and clear career pathways would also serve to guide the essential updating of radiographers' registration and licensing criteria by the Health Professions Council of Zambia (HPCZ) to extend the communities' benefit from radiographic practice.

6.3.6 Upgrading of Radiological Services

A clear relationship was noted between the types of human capabilities, radiological technology, and radiological service delivery. In terms of this relationship and the predicted advantage of radiographers' frontline extended roles, the radiographers need support to extend their competencies to influence corresponding upgrading of rural radiology departments, effective radio-diagnostic communication, and clinical-based CPD under radiologist and other appropriately qualified mentorship. Provision ought to be made for appropriately modern and adequate multimodality radiology departments with matching radiographic competencies and versatile digital technology to improve the quality of radiological services. The radiological service should be viewed as an interlinked single unit, and be adequately equipped with essential radiological equipment and technology, with some provision made for consultant radiologists to offer scheduled outreach radiological services. The upgraded provision would also reduce waiting time and referrals for, currently, scarce optimal radiological services, and improve prospects of

more advanced radiological procedures, such as interventional radiology, at third level hospitals.

6.3.7 Administrative Structure and Recruitment of Radiographers

There should be a radiological administrative structure that links the province with the Ministry of Health headquarters. A team leader of radiological services in the province should coordinate and standardise radiological services at related levels, as well as lead necessary innovations. When viewed within the national context, such leaders would interact with technical colleagues, other relevant professionals or Government officials to promote radiological service provision.

The quality of radiological service delivery should be overseen and monitored through client (physician and patient) satisfaction surveys. The hierarchical staffing levels of radiographers, to be determined, should address the realities of (a) the need for uninterrupted day and night services including in occasions of radiographers' training away from their departments, (b) multiple imaging rooms and modalities with the capacity to simultaneously handle emergency and routine radiological needs, (c) several areas of imaging and diagnostic reporting including contrast-aided radiography, CT, general ultrasonography and echocardiography, (d) dedicated management of radiology departments, and (e) radiographers' access to funded advanced education and training.

6.3.8 Further Research

This researcher suggests further research areas to build on this work and promote sustainable radiological service benefits to communities arising from advances in radiographic practice. Further research would focus on radiographer staffing levels and radiographer competencies in a multimodality radiology department. The extent of multiple radiographic extended roles beyond chest x-ray radiological reporting, and associated technology including ICT infrastructure, would be further study areas. In this regard, further research should determine criteria for cost-effective radiographer appointments towards comprehensive radiological services by healthcare facilities. The radiographers' levels of competencies and/or specialisations required at various levels of

healthcare such as district, provincial and national levels would be determined to aid dynamic service oriented radiographer recruitments. Such research should also interrogate motivation for innovative radiological work practice, as well as relationships among formal radiographic education and training, quality of CPD, modes of study and radiological productivity.

Other research would be required to determine workable categories of extended radiographic role competencies that the frontline radiographer would handle at prescribed level of education, training and mentorship. The research should ascertain and pilot practical means of incorporating teleradiology technology to support the concept of 'frontline' radiographic human capital for innovative extended role practice. The involvement of CPD supported by teleradiology under appropriate mentorship, including accessible consultant radiologists for incorporated outreach services, should be part of the intended study. In this way, areas of radiographic specialisations matching designated professional recognition, licensing of practice and associated radiological machinery or technology would be appropriately determined.

Further research should also be into delineating measurable levels of competencies based on human capital development measurement factors or criteria *[see Table 6]* addressing radiographic capability benchmarks linked to FRHCD Conceptual Framework's human capital capabilities and human capital processes *[see Figure 4]*. The outcome of such research should be drawn to initiating assessment tools towards necessary radiological or radiographic services policy of Ministry of Health, licensing of radiographers' extended role practice by Health Professions Council of Zambia, and promotion of employee engagement to be overseen by Radiological Society of Zambia.

Further Action Research design, guided by the FRHCD Conceptual Framework, should be undertaken in other rural or urban hospitals besides the geographical region covered by this study. This approach would assess comparable or divergent radiological needs to aid categorisation of the needs for possible remedial interventions among various communities. The study would investigate suggested radiological service remedies involving multidisciplinary healthcare teams, including physicians, in collaboration with the radiology departments or radiographers for the provision of desirable radiological

services. A multidisciplinary perspective, subject to profession-specific competency needs, in the interest of well harmonised advanced radiographic practice and upholding pace with innovations in radiological service delivery would be worthwhile.

6.4 Limitations of the Study

As Baumgärtner, Strong, and Hensley (2006) have maintained, limitations that lie outside of the researcher's control are evident in all research projects. These limitations are able to influence the degree to which findings may be extrapolated. This study focused on the Western Province of Zambia, as a representation of the radiological service provision within predominantly rural areas of Zambia served by radiographers rather than jointly with radiologists. Approximately 61 percent of Zambia's population lives in rural areas (Central Statistical Office, 2011), and radiological human capital deficiencies are broadly comparable with that of the Western province of Zambia as one needy perspective of radiological services in Zambia. The study focussed on such healthcare facilities, notwithstanding comparable facilities would equally be located in urban areas. The results and recommendations arising from this study, therefore, are able to be extrapolated, minimally, to the other rural provinces of Zambia, or other countries and regions experiencing similar challenges with respect to radiological human capital and the associated need for equitable diagnostic radiological service provision.

The divergent literacy levels encountered during the patients' interviews called for communication within the participating patients' preferred languages regarding radiological service provision. Whilst both the researcher and research assistant were fluent in the universally spoken local languages, and applicable communication expressions in the province, the interviews did not involve scientific or technical terminologies which could have posed limitations in local language translations.

The low turnout of radiographer participants in the third phase, involving training in Lusaka, could be attributed to discretionary precautions to maintain uninterrupted radiological services whilst some radiographers were undergoing training. Unlike for first phase and second phase participation, the third phase of the study included a requirement for the participating radiographers to travel from Western province to Lusaka for training.

Nevertheless eight out of 17 radiographers released for training in a region with the shortage of radiographers might be indicative of what is feasible to achieve in such a region.

The study needed to be accomplished within the feasible resources and duration, and determined educational criteria leading to six radiographers completing the training programme and participating in the fourth phase. There was need to maximize the trainees' clinical training time by primarily focusing on chest x-ray diagnostic reporting, the most common x-ray examination, as a strategy for better prospects of evident capabilities following eight weeks duration of radiographers training. Similarly, the study was feasibly confined to one cycle, comprising four phases, up to evaluation phase leading to recommendation for way forward thereafter.

The precautionary measure to enhance radiological reporting accuracy where at least two radiographers were required to jointly make each diagnostic report inevitably impeded the rate at which the radiological investigations were accomplished. The consultation with radiologists in Lusaka, where required to conclude a report, entailed further slowing down of the reporting rate. There were limitations to accomplishing other radiological investigations accompanied by diagnostic reports, besides chest x-ray investigations. The radiographers were strategically prepared to report on chest x-ray images during the two months training within limited timeframe, which was inadequate for larger scope of radiographers' extended clinical capabilities.

The participants identified a number of gaps in radiological service delivery in this study, which included infrastructure and equipment deficiencies associated with poor quality of imaging and radiological services. Unfortunately, these areas fell outside the primary focus of the study, which was radiographic human capital development. Hence the planned intervention involved the training of radiographers towards initiating positive influence to uplifting other relevant areas of quality innovations. Furthermore, some participants had indicated a need for the training of clinicians. Such training could not be attended to in the context of this study. The researcher, as a radiographer, had no jurisdiction over human capital development among clinicians. Such a limitation could have, potentially, restricted radiological service utilisation in case of uncertainties among

clinicians' radiological requests regarding the feasible radiological services and radiographers' capabilities.

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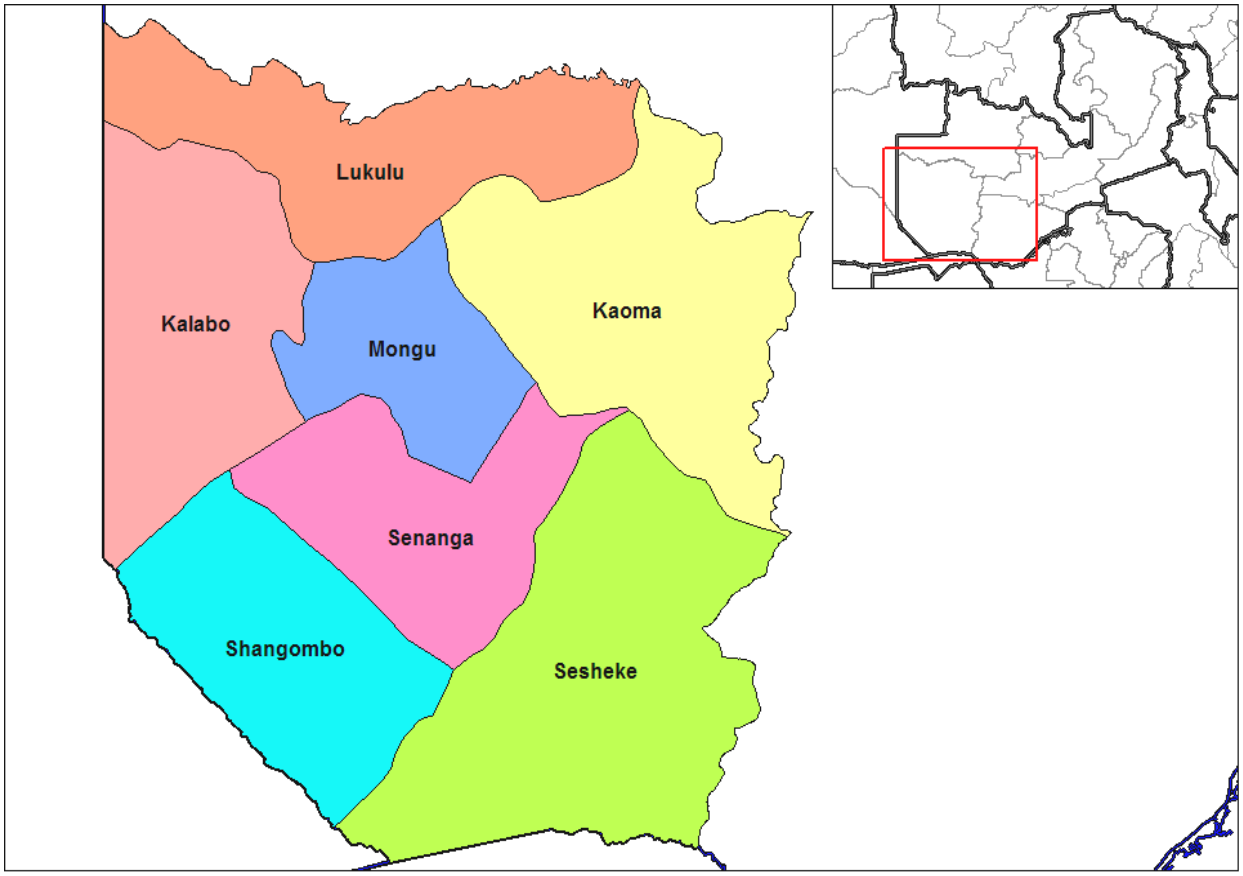
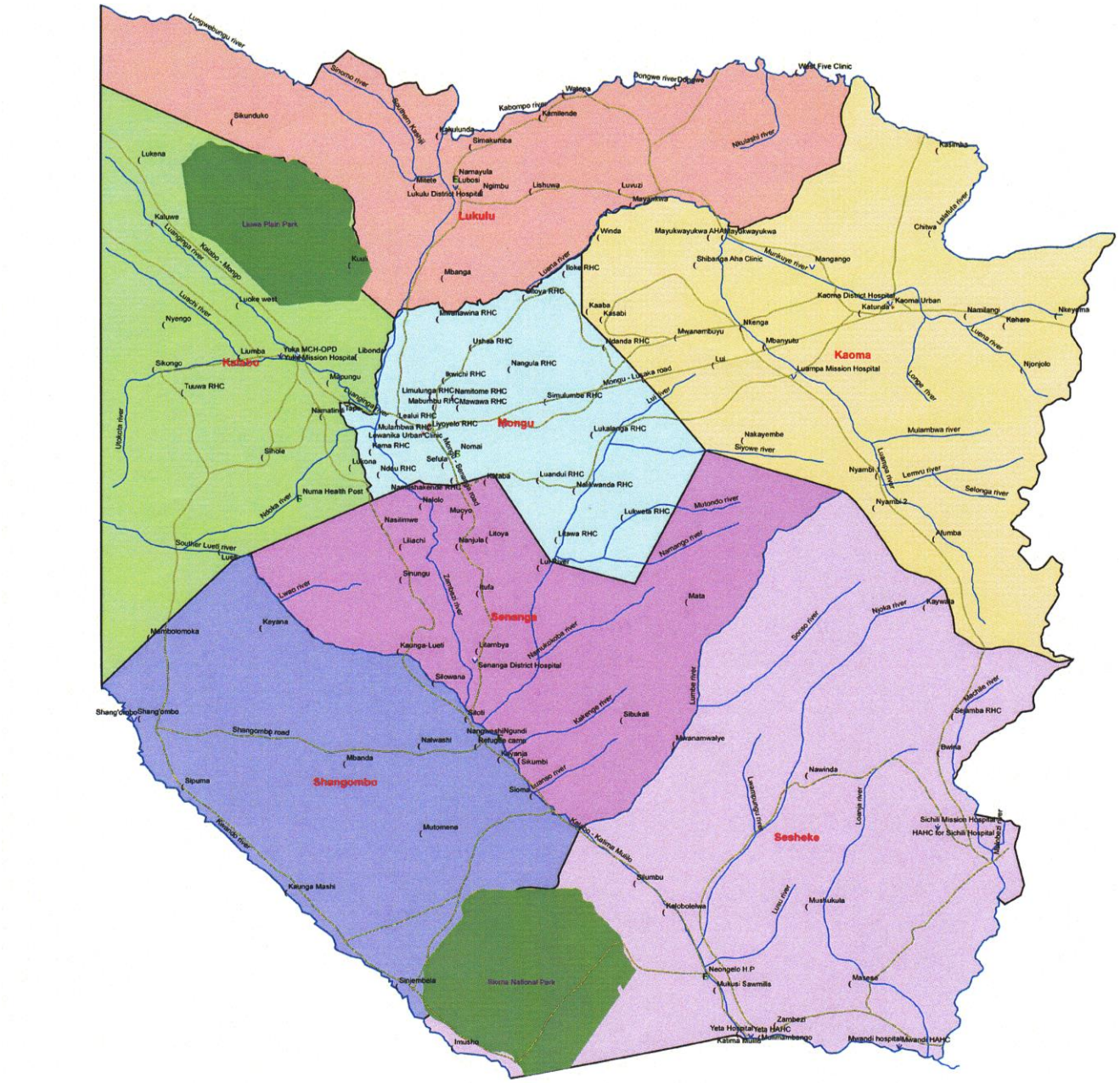
APPENDIX 1: Research Phases and the Linked Objectives

Research Phases	**Objective Number**	*Summarised* **Objectives of Research**	*Defined* **Process of Action Research**	**Research Process Tool/s**	**Participants**
One	1 and 2	1. Analyse existing radiological services and/or practices in rural Zambian healthcare facilities without radiologists. 2. Examine views of radiographers, physicians and patients/clients in hospitals without radiologists on adequacy of radiological service delivery.	Problem Diagnosis	1. Interviews Schedules inclined to theoretical framework. 2. Document Analysis Guide.	• Healthcare practitioners • Patients
Two	3 and 4	1. Determine desirable competencies for frontline radiographers in comprehensive radiological services delivery, as well as benefits of such competencies to the community and service health service facilities. 2. Analyse the managements' expectations regarding frontline radiographers' capabilities in rendering comprehensive radiological services in healthcare settings without radiologists.	Planning Action	1. Questionnaire with closed-ended and open-ended questions inclined to first phase outcome.	• Healthcare practitioners • Other experts in: radiography or radiology education and training, policy, regulation and professional development.
Three	5	3. Formulate, implement, and evaluate the radiographers' training programme for comprehensive radiological services.	Taking Action	1. Training programme. 2. Programme evaluation Questionnaire	• Radiographers • Radiology Trainers
Four			Evaluating the outcome of intervention/ action (scope and benefits) for way forward.	2. Client Satisfaction questionnaire.	• Physicians • Patients (Radiographers as service providers)

APPENDIX 2: Location of the Seven Districts of the Western Province of Zambia



APPENDIX 3: Western Province Healthcare Facilities



APPENDIX 4: The Practitioners' Interview Schedule

FRONTLINE RADIOGRAPHIC HUMAN CAPITAL DEVELOPMENT – A Case of Zambia and Way Forward

Hospital……. Province…… Date…….

Profession [tick Y]:

Physician [ ] Radiographer [ ] Healthcare Manager [ ] Other Occupation (specify): .....

TIERS *(for researcher use)*	**CONTENT**	**RESPONSE** *(researcher's notes from audiotape)*
Human Capital Process	**Outline local:** (1) current radiography education, training/skills, (2) Continued Professional Development, (3) radiography career path, (4) related comment.	
Human Capital Capabilities	**Reflect on:** (5) attitudes/engagement of practitioners regarding in radiology or radiography, (6) technical abilities for rendering services in; conventional radiography, radiological reporting, diagnostic ultrasound, contrast media-aided procedures.	
Key Performance Drivers	**Highlight:** (7) radiological productivity (output), (8) quality of radiological/radiographic services, (9) patient satisfaction with the service, (10) physician satisfaction with the service, (11) related comment	
Service Result	**State:** (12) radiological procedures performed, (13) desired procedures, (14) benefits from available radiological services, (15) consequences of unavailable radiological services, (16) related comment.	

APPENDIX 5: The Patients' Interview Schedule

FRONTLINE RADIOGRAPHIC HUMAN CAPITAL DEVELOPMENT – A Case of Zambia and Way Forward

Age: ..... Gender: ..... Area Address: .....

Occupation: ..... Date: .....

Previous Radiological Examination: .....

Current Radiological Examination: .....

TIERS *(for researcher use)*	**CONTENT**	**RESPONSE**
Human Capital Process	**State your**: (1) expectation from the radiological service	
Human Capital Capabilities	**Suggest:** (2) how one service you wish to recommend would generally improve radiological services.	
Key Performance Drivers	**Highlight:** (3) how you rate the service with radiological report, (4) how you rate the service without radiological report, (5) in your opinion, one most satisfying service from the radiology department: **Comment on:** (6) reason for being satisfied or unsatisfied in your respective last two radiological examinations.	**(Tick Y opinion):** (3) satisfactory or unsatisfactory, (4) Satisfactory or unsatisfactory, (5) advanced machinery, communication of radiological findings, or friendly radiology staff. **Comment:** (6) ……
Service Result	**In your opinion, State:** (7) benefit of radiological services to clients/patients, (8) consequences of limited radiological services. (9) highlight other related comment:	(7) (8) (9) ……..

APPENDIX 6: Document Analysis Guide to Radiological Service Delivery

FRONTLINE RADIOGRAPHIC HUMAN CAPITAL DEVELOPMENT – A Case of Zambia and Way Forward

Hospital……. ……Province……Date Accessed: ……...

Source Document: Radiology Registers or Records, Hospital Registers or Records, or Other Sources

Period Covered: (month and year)	**Patient's Residential Area:** (state area and district)	**Requested X-Ray Investigation:** (state body part/region or clinical question)	**Diagnostic X-Ray Conclusion:** (confirm diagnostic report)	**Patient Outcome:** (confirm clinical outcome based on radiological result – treatment, referral, other)	**Expense Needs by patient or hospital, if referred:** (specify - transport, lodging, or other need)	**Other Relevant Data:**
Summary Notes:						

APPENDIX 7: Questionnaire for Practitioners

FRONTLINE RADIOGRAPHIC HUMAN CAPITAL DEVELOPMENT – A Case of Zambia and Way Forward

A. Designation

Please tick [Y] the designation that most appropriately defines your position, from the list arranged in alphabetical order, below:

1. Healthcare Manager [ ]
2. Health Professions Council Management Official [ ]
3. Health Professions Council Education Committee Member [ ]
4. Physician [ ]
5. Radiographer [ ]
6. Radiography Lecturer [ ]
7. Radiography Clinical Instructor [ ]
8. Radiological Services/Imaging Specialist [ ]
9. Radiological Society Executive/Radiography Practice Representatives [ ]
10. Radiologist [ ]
11. Training Standards Officer [ ]

B. Frontline Radiographic Human Capital Development Plan [tick Yas desirable]

1. In an attempt to offer comprehensive radiological services in most areas of Zambia where there are no radiologists, which of the following interventions would you recommend as realistically viable?
   1.1 The few radiologists to follow schedule of visiting all areas requiring their services [ ]
   1.2 Upgrade radiographers' roles and communication between physicians and the available few radiologists [ ]
   1.3 Other comment: .....
2. Which of the following capabilities would you recommend as feasible areas of education and training to extend the radiographers' roles in the current context?
   2.1 Preliminary diagnostic reports on conventional radiological images [ ]
   2.2 None [ ]
   2.3 Other comment: .....
3. In your opinion, in order of preference, kindly cite three priority workable solutions towards comprehensive and equitable accessibility of radiological service in Zambia despite unforeseen improvement in the low number of radiologists, amidst unfolding overwhelming workload.

   3.1 .....

   3.2.....

   3.3.....

APPENDIX 8: Priority Ranking Worksheets of Practitioners' Preferences

Practitioner Questionnaire Part 3.1 First Priority Recommendations

1. Assess the availability and distribute personnel evenly
2. Inclusion of isotopes in the curriculum
3. Improvement and increase of interpretative skills in radiography
4. High level of training of radiographers
5. Teleradiology
6. Training of radiographers for extended roles
7. Extended roles of radiographer
8. Telemedicine to be introduced
9. Extending the roles of radiographers
10. Train more of radiolographers in new imaging technologies
11. Train radiographers to include radiological reporting
12. Capacity building with radiological extended roles
13. Retrain and upgrade existing skills
14. To train and orient local doctors in radiology
15. Silent
16. Introduce teleradiology
17. Introduce more universities and colleges for radiology
18. Upgrade radiography
19. Train experienced radiographers into extended roles
20. Extended radiography roles in preliminary reporting
21. Train more radiologists
22. Upgrade radiographers to degree level
23. Train radiographers to conventional x-ray reporting.
24. Train radiographers in diagnostic reporting
25. Establishment of radiologists per provinces
26. Availability radiology human resource and upgrade radiological equipment at district hospitals.
27. Internship programmes for newly qualified radiographers [for extended radiological skills].
28. Building capacity of existing radiographers
29. Training of radiographers in relevant skills
30. Train more radiographers and post them to areas where there are none.
31. Reporting on images by radiologists
32. Training of more radiographers
33. Provide ultrasound machine to hospitals
34. Increase the intake of radiographers
35. Train radiologists
36. Radiologists to be visiting hospitals without radiologists.
37. Increase the number of radiographers
38. Encourage short courses and training in radiology

39. Upgrade radiographers
40. Upgrade radiographers' roles.
41. Increase the number of radiographers
42. Commence the degree programme in radiology
43. Distribute available radiologists to general hospitals
44. Train more radiologists.
45. Capacity build radiographers to extended roles in both ultrasound and radiography
46. Upgrade radiographers to meet problems in hospital institutions
47. Train radiographers in basic radiological services
48. Upgrade radiographers' training.
49. Train radiographers to perform traditional radiologists' roles
50. Train existing radiographers and equip then with orientation in modern radiological technology
51. Provision [and application] of teleradiology technology.
52. Improvement of equipment
53. Radiography diagnostic reporting
54. Introduction of advanced training for radiographers
55. Extension of radiographers' roles
56. Train radiographers in ultrasound
57. Train radiographers to competently do specialised investigations.
58. Upgrade radiographers' roles; e.g. film reporting.
59. Silent
60. Availability of functional x-ray units
61. Continued Medical Education [Continued Professional Development] to upgrade radiographers

Practitioner Questionnaire Part 3.2 **Second Priority Recommendations**

1. Introduce X-ray Assistants course to ease the workload on a few radiographers
2. Let the Radiological Association of Zambia be proactive in dealing with issues concerning the radiographers
3. Provincial seminars/workshops to address challenges in the province
4. Train radiographers for rural practice
5. Extend radiographers roles.
6. Introduction of teleradiology to network radiology departments with radiologists at University Teaching Hospital (UTH).
7. Open postgraduate radiology programme at University of Zambia.
8. Two more institutions for radiographers to be opened.
9. Advanced radiography practice
10. Introduce conventional radiological image reporting.
11. Encourage clinical meetings and presentations for radiographers and radiologists.
12. Provide incentives to radiographers
13. Increase output of radiographers from colleges.

14. Radiographers need detailed information in clinical medicine, pathology, & treatment protocols

15. *Silent*

16. Train radiographers to do basic radiological procedures.

17. Carry out more seminars to teach radiographers on reports.

18. Introduce telemedicine facilities to allow radiographers an option to consult the few radiologists.

19. Train more radiologists.

20. In the improvement of the facility: - teleradiology

21. Distribute radiologists so that there is at least one in each district.

22. Train more radiographers to level of radiologists

23. Ensure each district has machine like computerised tomography (CT) to improve service delivery, images reported through Picture Archiving Communication System (PACS).

24. Clinical officers should be oriented in diagnostic reporting.

25. Facilitate communication among radiology departments.

26. Establish radiology referral centres at provincial levels throughout the country.

27. Refresher courses on new radiological techniques.

28. Increase scope of materials/training/skills at radiography schools.

29. Upgrading the existing radiographers.

30. New equipment in the radiology department.

31. Mentoring and orientation of untrained staff.

32. Train other staff on basic radiography.

33. Provide ultrasound machine to Yuka hospital

34. Improve the teaching methods and syllabus for radiographers

35. Ensure regular servicing and upgrading of current radiological equipment in line with current trends.

36. Increase the number of student radiologists in institutions of training.

37. Upgrade radiographers.

38. Improve communication between radiologist and people involved in radiology using internet.

39. Train more radiologists

40. Upgrade radiographers' communication between physicians and available radiologists.

41. Improve the conditions of service

42. Telemedicine in radiology

43. Upgrade radiographers' role

44. Create more positions for radiologists on payroll starting with provincial towns and district hospitals.

45. Develop teleradiology technology to facilitate communication on matters concerning accurate diagnosis.

46. *Silent*

47. Use of telemedicine facilities

48. Radiologists should visit provincial hospitals.

49. Provide modern radiological equipment

50. Equip radiographers with modern changes in technology; change from analogue to digital.

51. Extend radiographer roles by offering them radiological skills training.

52. Upgrade radiographers' roles by attending short training.

53. A course in ultrasonography

54. Upgrade radiographers' roles to report on radiographs.

55. Add value to local/National radiographic training programme by upgrading the qualification to minimum of degree.

56. Introduce the degree programme in radiography.

57. Introduce teleradiology in all general/district hospitals for easy access to the radiologist.

58. Government should train more radiographers

59. *Silent*

60. Provide ultrasound machines and services per hospital setting.

61. The Radiologists to follow visiting schedule.

PRACTITIONER Questionnaire Part 3.3 **Third Priority Recommendations**

1. Silent
2. Come up with internship guidelines for the radiographers
3. Annual National seminars – rotational hosts.
4. Extended roles in specialism among the radiographers
5. Train radiologists
6. Training of radiologists should be prioritised by Ministry of Health.
7. Include sonography and pattern recognition in current curriculum for radiography
8. Extended roles for radiographers should be introduced.
9. Develop licensing guidelines to govern delivery of radiography services at level of advanced radiography practice.
10. Introduce one more schools of radiography
11. Increased funding to radiography training to allow postbasic qualifications
12. Improve on equipment
13. Improve availability of equipment in hospitals
14. Silent
15. Silent
16. Certain radiological requests such as angiograms to be done with alternative imaging modalities like Doppler ultrasound where applicable.
17. Part of reporting to be introduced at diploma level
18. Improvement in the equipment currently in use especially in rural areas
19. Silent
20. Capacity building of radiographers.

21. Train radiographers to read /interpret images
22. Ensure visiting of radiologists in centres
23. Introduce degree programme in Zambia for radiographers
24. Improve interactions between radiographers-physicians
25. Workshops every after 2months in the radiology department
26. Motivation of radiographers(monetary and capacity building)
27. Visiting schedules for radiologists
28. Distribution of existing radiology staff [radiographers] equitably
29. Improving communication skills between the physicians
30. Offering short courses for un-qualified staff e.g. on reporting of images
31. Upgrade of radiological equipment
32. Silent
33. Provide x-ray machines to Yuka hospital
34. More workshops to be provided and technical supports to those in resource limited settings
35. Offer Continued Medical Education (CME) to clinicians in radiological diagnostic services
36. Silent
37. Improve radiological service facilities
38. Improve accessibility of radiologists
39. Train more radiographers
40. Training of enough radiologists
41. Make available the necessary equipment for better performance
42. Transfer radiologists to provincial health hospitals
43. Training of more radiologists(long term)
44. Increase enrolment in colleges and universities for radiologists.
45. Train more radiologists – an act which can take more time/years.
46. Silent
47. Inclusion of other key courses in the radiography training which would make the radiographer more competent and knowledgeable e.g. pathology, pharmacology
48. Radiologists to be visiting district hospitals every 6months
49. Motivate providers of radiological services (better salaries, housing and other conditions of service).
50. Provide modern equipment; CT, MRI, Radiotherapy/ - Nuclear medicine.
51. Improve on tertiary education offering radiological services
52. Work hand-in-hand with physicians.
53. Putting up proper infrastructure, reliable x-ray machinery and accessories.
54. Technical support [visits] from the few radiologists.
55. Take deliberate steps to equip already available general practitioners [radiographers] with radiological skills through short courses; e.g. basics in ultrasound, disease pattern recognition, etc.
56. Allow radiographers to report on film too.

57. Have scheduled visits by the radiologists when need arises.
58. Introduction of the degree programme in the country.
59. Silent.
60. Training in ultrasound.
61. Telemedicine.

APPENDIX 9: Preferences by Participants towards Improved Radiological Services

Thematically arranged proposed remedial interventions to improved accessibility of radiological services:	Priority (columns) and thematic(rows) preference frequencies:			
	One	Two	Three	Total
Upgrade radiography education and training equipment.	16	7	6	29
Establish extended radiographic capabilities with funded internship programmes.	18	12	9	39
Promote Continuing Professional Development (CPD) among radiographers.	2	5	2	9
Provide more radiographers from several radiography schools.	8	3	3	14
Provide professionally approved radiological equipment equitably distributed to all the hospitals and regularly serviced.	3	6	10	19
Establish positions of radiologists in the provinces and train more radiologists.	6	5	7	18
Establish teleradiology communication technology and /or consultancy interactions among the physicians, radiographers and radiologists.	4	10	5	19
Schedule radiologists' clinical visits to the radiology referral department to be established in the province.	1	3	5	9
Train or orient physicians and other suitable healthcare personnel in some radiological procedures.	1	4	2	7
Generate proactive commitment from the Radiological Society of Zambia in representing the radiographers' professional welfare.	0	3	3	6
Develop licensing guidelines to govern extended radiography practice.	0	0	1	1
Overall frequencies:	59	58	53	170

APPENDIX 10: Durban University of Technology Ethics Approval

DURBAN UNIVERSITY of TECHNOLOGY

Faculty of Health Sciences

ETHICS CLEARANCE CERTIFICATE

Student Name	Foster Munsanje	**Student No**	20718563
Ethics Reference Number	FHSEC 001/01	**Date of FRC Approval**	14 01 2010
Qualification	**Doctor of Technology in Radiography**		
Research Title:	**Frontline Radiographic Human Capital Development: A case of Zambia and Way Forward**		

In terms of the ethical considerations for the conduct of research in the Faculty of Health Sciences, Durban University of Technology, this proposal meets with Institutional requirements and confirms the following ethical obligations:

1. The researcher has read and understood the research ethics policy and procedures as endorsed by the Durban University of Technology, has sufficiently answered all questions pertaining to ethics in the DUT 186 and agrees to comply with them.
2. The researcher will report any serious adverse events pertaining to the research to the Faculty of Health Sciences Research Ethics Committee.
3. The researcher will submit any major additions or changes to the research proposal after approval has been granted to the Faculty of Health Sciences Research Committee for consideration.
4. The researcher, with the supervisor and co-researchers will take full responsibility in ensuring that the protocol is adhered to.
5. ***The following section must be completed if the research involves human participants:***

	YES	NO	N/A
❖ Provision has been made to obtain informed consent of the participants	✓		
❖ Potential psychological and physical risks have been considered and minimised	✓		
❖ Provision has been made to avoid undue intrusion with regard to participants and community	✓		
❖ Rights of participants will be safe-guarded in relation to:	✓		
- Measures for the protection of anonymity and the maintenance of Confidentiality.			
- Access to research information and findings.	✓		
- Termination of involvement without compromise	✓		
- Misleading promises regarding benefits of the research	✓		

[redacted]
SIGNATURE OF STUDENT/RESEARCHER — 20 12 2009 DATE

[redacted]
SIGNATURE OF SUPERVISOR/S — 20 12 2009 DATE

[redacted]
SIGNATURE OF HEAD OF DEPARTMENT — 22 12.2009 DATE

[redacted]
SIGNATURE: CHAIRPERSON OF RESEARCH ETHICS COMMITTEE — 14.01.2010 DATE

APPENDIX 11: University of Zambia Ethics Approval

THE UNIVERSITY OF ZAMBIA

BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
Fax: + 260-1-250753
E-mail: unzarec@unza.zm
Assurance No. FWA00000338
IRB00001131 of IORG0000774

Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia

27 May, 2010
Ref.: 020-05-10

Mr Foster Munsanje
Evelyn Hone College
Health Sciences Department
P.O. Box 30029
LUSAKA

Dear Mr Munsanje,

RE: SUBMITTED RESEARCH PROPOSAL: **"FRONTLINE RADIOGRAPHIC HUMAN CAPITAL DEVELOPMENT – A CASE OF ZAMBIAN AND WAY FORWARD"**

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee where changes/clarifications were recommended. The proposal was found to have minimal ethical issues. The proposal is now approved.

CONDITIONS:

- This approval is based strictly on your submitted proposal. Should there be need for you to modify or change the study design or methodology, you will need to seek clearance from the Research Ethics Committee.
- If you have need for further clarification please consult this office. Please note that it is mandatory that you submit a detailed progress report of your study to this Committee every six months and a final copy of your report at the end of the study.
- Any serious adverse events must be reported at once to this Committee.
- Please note that when your approval expires you may need to request for renewal. The request should be accompanied by a Progress Report (Progress Report Forms can be obtained from the Secretariat).
- **Ensure that a final copy of the results is submitted to this Committee.**

Yours sincerely,

[redacted]

Dr James Munthali
A/CHAIRPERSON

Date of approval: 27 May, 2010 **Date of expiry**: 26 May, 2011

APPENDIX 12: Zambian Ministry of Health Approval

All Correspondence should be addressed to the
Permanent Secretary
Telephone: +260 211 253040/5
Fax : +260 211 253344

In reply please quote:

No.....

REPUBLIC OF ZAMBIA

MINISTRY OF HEALTH

NDEKE HOUSE
P. O. BOX 30205
LUSAKA

MH/101/17/6

7th June 2010

Mr Foster Munsanje
Evelyn Hone College Management Board
Department of Health Science, Radiography Section
P.O Box 30029
LUSAKA

Dear Mr Munsanje,

Re: Request for Authority to Conduct Research

We are in receipt of a request for authority to conduct a study on **"Frontline radiographic human capital development - A case of Zambia and way forward"**. I wish to inform you that following submission of your research proposal to my Ministry, our review of the same, my Ministry has granted you authority to carry out the study on condition that:

1. The relevant Provincial and District Directors of Health where the study is being conducted are fully appraised;
2. Progress updates are provided to MoH quarterly from the date of commencement of the study;
3. The final study report is cleared by the MoH before any publication or dissemination within or outside the country.

I consider your research topic to be of policy relevance in human resource development.

Yours sincerely,

[redacted]

Dr. P. Mwaba
Permanent Secretary
MINISTRY OF HEALTH

c.c. Director Public Health and Research

APPENDIX 13: Provincial Medical Office Approval – Western Province of Zambia

All correspondence should be addressed to the
Provincial Health Director

Tel: 0217-221246 / 221381
Fax: 0217-221428

In reply please quote:

No. MH/WP

REPUBLIC OF ZAMBIA

MINISTRY OF HEALTH

PROVINCIAL HEALTH OFFICE
P.O. Box 910022
Plot No. 4503
Independence Road
MONGU - ZAMBIA

July 30, 2010

The District Directors of Health,
The Executive Director Lewanika Hospital,
Western province

Re: Research Project; Frontline Radiographic capital development- A case of Zambia and Way Forward

Find attached authority signed by the Permanent Secretary Ministry of Health, for Mr. Foster Munsanje to conduct a research. The research project is Frontline Radiographic capital development- A case of Zambia and Way Forward.

Kindly allow Mr. Munsanje to proceed with the project in your hospitals as is in the approved terms of the research.

[redacted]

Dr. A. M. Sitali
Provincial Medical Officer
Western Province

APPENDIX 14: Information Sheet about the Study

FRONTLINE RADIOGRAPHIC HUMAN CAPITAL DEVELOPMENT – A Case of Zambia and Way Forward

Principal Investigator/s: Foster Munsanje (Mr.)

Supervisor/s: Prof. Nomthandazo S Gwele

Brief Introduction and Purpose of the Study:
Currently, there is no radiologist in the Western province of Zambian and several other provinces, thereby posing a huge challenge to offer improved healthcare services and to the Zambian Ministry of Health vision for equitable distribution of health services as re-emphasised in the current Fifth National Development Plan. Whereas extended radiographers' skills in some more developed countries have been appreciated under direct supervision of radiologists, Zambia stands with far too few radiologists to contain such mode of supervision to benefit all citizens. The purpose of the study, therefore, is to develop sustainable human capital developmental guidelines embracing reliable advanced radiography practice in Zambia, with special focus on radiological settings without radiologist, thereby serving most citizens up to remotest habitats of livelihood.

Outline of the Procedures:
The study will take an Action Research approach, where various stakeholders will be invited to actively take part during some successive phases, arranged as follows:

1. Problem diagnosis – through radiological document analysis and interviewing practitioners.
2. Action planning – through use of questionnaires in examining the views of stakeholders regarding adequacy of radiological service.
3. Acting on gathered views in formulating and demonstrating desirable competencies for frontline radiographers in comprehensive radiological services delivery.
4. Evaluating output benefits of demonstrated competencies in Phase 3 to the clients/patients.
5. Develop a framework for human capital development for frontline radiographers in rendering comprehensive radiological services where there are no onsite radiologists.

Risks or Discomforts to the Participants:
Not applicable in biophysical terms, being Human Capital Development study with associated concerns highlighted under Confidentiality, below. Where applicable, each interview will not exceed 30 minutes exclusive of 5 minutes for possible clarifications based on scheduled items.

Benefits:
The end output is expected to contribute to improved healthcare delivery and satisfaction among participants. The modes of disseminating the research report will be communicated through the participating institutions to enable the participants appreciate their contribution.

Reason/s why the Subject May Be Withdrawn from the Study:
Generally nil from the researcher's perspective, other than where the participant voluntarily opts to withdraw with or without giving reason/s.

Remuneration:
Not Applicable.

Confidentiality:
The participants' names, other than their professions and employing organisations, will be withheld in the research report and preceding data collecting processes. With regard to document analysis and evaluation of the service, names of clients in the hospital documents will strictly be left anonymous. Any participant will have the freedom to withdraw participation at any point without any penalty or need for justification. The research will strictly dwell within the professional ambit in line with purpose of the study and devoid of slander or infringement to institutional standing.

Research-related Injury:
Not applicable.

Persons to Contact in the Event of Any Problems or Queries:

Chairperson
Biomedical Research Ethics Committee
University of Zambia
Ridgeway Campus
P.O. Box 50110
Lusaka.
Phone: 211 256067
E-mail: unzarec@unza.zm

Foster Munsanje
Evelyn Hone College, Radiography Section
P.O. Box 30029,
Church Road, Lusaka.
Zambia.
Phone: +260 977 793204
E-mail: fostermunsanje25@yahoo.co.uk

APPENDIX 15: Consent Form for Participation in the Study

FRONTLINE RADIOGRAPHIC HUMAN CAPITAL DEVELOPMENT – A Case of Zambia and Way Forward

Province…… Hospital……. Date…….

Profession [tickY]: Physician [ ] Radiographer [ ] Other Occupation (specify).....

Title of the Research Study:
FRONTLINE RADIOGRAPHIC HUMAN CAPITAL DEVELOPMENT – A Case of Zambia and Way Forward

Principal Investigator: Foster Munsanje (Mr.)

Supervisor: Prof. Namthandazo S Gwele

Statement of Agreement to Participate in the Research Study:

I,……(participant's full name), ID number……., have read the Information Sheet in its entirety and understand its contents. Where I have had any questions or queries, these have been explained to me by ……....to my satisfaction. Furthermore, I fully understand that I may withdraw from this study at any stage without any adverse consequences and my healthcare will not be compromised. I, therefore, voluntarily agree to participate in this study.

Participant's name *(print)***:** ……**Signature or Thumbprint:** …….....

Date: …….....

Researcher's name *(print)***:** ……....**Signature:** ……..

Date: .....

Witness' name *(print)***:** …….....**Signature:** …….....

Date: …….....

Supervisor's name *(print)***:** ...……..**Signature:** ……...…..

Date: .....……

Persons to Contact in the Event of Any Problems or Queries:

Chairperson
Biomedical Research Ethics Committee
University of Zambia
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P.O. Box 50110
Lusaka.
Phone: 211 256067
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P.O. Box 30029,
Church Road, Lusaka.
Zambia.
Phone: +260 977 793204
E-mail: fostermunsanje25@yahoo.co.uk

APPENDIX 16: Information Sheet and Request to Complete the Questionnaire

Title of the Research Study:

FRONTLINE RADIOGRAPHIC HUMAN CAPITAL DEVELOPMENT – A Case of Zambia and Way Forward

Principal Investigator: Foster Munsanje (Mr.)

Supervisor: Prof. Namthandazo S Gwele, Durban University of Technology.

Brief Introduction and Purpose of the Study: Currently, there are no radiologists in most Zambian provinces, thereby posing a huge challenge to offer improved healthcare services and to Zambian Ministry of Health vision for equitable distribution of health services as re-emphasised in the Fifth National Development Plan. Whereas extended radiographers' skills in some more developed countries have been appreciated under direct supervision of radiologists, Zambia stands with far too few radiologists to contain such mode of supervision to benefit all citizens. The purpose of the study, therefore, is to develop sustainable human capital developmental guidelines embracing reliable advanced radiography practice in Zambia, with special focus on radiological settings without radiologist, thereby serving most citizens up to remotest habitats of livelihood.

Outline of Phases:

1. Problem diagnosis – through radiological document analysis and interviewing practitioners.
2. Action planning – through use of questionnaires in examining the views of stakeholders towards adequacy of radiological services.
3. Acting on gathered views in formulating and demonstrating desirable competencies for frontline radiographers in comprehensive radiological service delivery.
4. Evaluating output benefits of demonstrated competencies in phase 3 to the clients/patients.
5. Develop a framework for human capital development for frontline radiographers in rendering comprehensive radiological services where there are no onsite radiologists.

Benefits: The end output is expected to contribute to improved healthcare delivery and satisfaction among involved practitioners and affected clients. The modes of disseminating the research report will be communicated through the participating institutions to enable the participants appreciate their contribution.

Confidentiality: The participants' names, other than cited designations, will be withheld in the research report and preceding data collecting processes. The research will strictly dwell within the professional ambit in line with purpose of the study and devoid of slander or infringement to institutional standing.

Persons to Contact in the Event of Any Problems or Queries:

Chairperson
Biomedical Research Ethics Committee
University of Zambia
Ridgeway Campus
P.O. Box 50110
Lusaka.
Phone: 211 256067
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Foster Munsanje
Evelyn Hone College, Health Sciences Department
P.O. Box 30029
Church Road, Lusaka.
Zambia.
Phone: +260 977 793204
E-mail: fostermunsanje25@yahoo.co.uk

You are hereby invited to take part through the attached questionnaire representing 2nd phase of the above cited outline. Completion of the questionnaire may take about twenty-five minutes on average depending on extent of comments where applicable.

Thank you.

(Signed)
Foster Munsanje

APPENDIX 17: Medical Imaging/X-ray Report Form

.....X-RAY REPORT

Date:.....Hospital/Clinic.....

Name:.....sex.....age..... No. 255

Clinical History:
X-Ray No:
Findings:
Other Findings
COMMENT:

Reporting practitioner.....

APPENDIX 18: Training Programme Evaluation Questionnaire

Diagnostic Pattern Recognition and Reporting for Radiographers (DP3R)

Date: …….....

This questionnaire is meant to help us improve the quality of the training programme you have just undertaken/conducted. Kindly answer the questions below as truthfully as possible. You are not obliged to identify yourself, other than indicating by ticking [Y] whether you are trainer ……or trainee ……. in the programme.

Please tick one choice for each question or provide brief response in spaces provided:

1.0 Aim and Learning Environment:

1.1 Determine general goals and specific objectives, whether: [Tick Y]:
appropriate …… or inappropriate.....
1.2 Determine the characteristics of learning environment for the training programme: appropriate ….. or inappropriate…....
1.3 Identify challenges to meeting programme goal and objectives: .....
.....

2.0 Training Resources Sustenance:

2.1.1 SWOT Analysis [state];
2.1 **S**trengths…….....
2.2 **W**eaknesses …….....
2.3 **O**pportunities……
2.4 **T**hreats …….....
2.2 Determine, in general terms, the resources needed to effectively deliver the programme: ……...
2.3 Determine whether available staff and/or resources are adequate to implement the programme: ……....

3.0 Complete Implementation Learning Process:

3.1 Suggest appropriate evaluation methods of the training programme for training goal/s: …….....
.....
3.2 Determine information necessary to policy makers to determine if the programme needs to be accepted, amended, or terminated: ……
.....

3.3 Identify inconsistency or consistency between the piloted and intended programme for implementation: .....……....
.....

4.0 Forecasted Outcome:

4.1 Comment on clinical outcome goal of the programme: …….....
.....
4.2 Forecast the outcome skills from the programme: ……
.....
4.3 Compare the forecasted skills with other known similar programme/s, where applicable:.....…….....….....…
.....

5.0 Comment further on preferred forecasted skills and programme sustainability:

5.1 …….....
5.2 .....…….....

APPENDIX 19 : Summary of X-Ray Examinations Performance by Document Analysis of a Month Preceding the Study

Hospitals (numbered 1 to 11)	Summary of Examined Body Regions	Rate of Most Common X-ray Examinations	Summary of Indications for Referrals	Number of Referrals
1	Abdominal, Chest, Head, Musculoskeletal, and Pelvic; based on varied systems, organs or structures, and varied associated indications across all age groups; all without radiological reports.	Chest: 280÷360 *(77.7)*	• Undetermined possible tuberculosis. • Persistent osteomyelitis for specialised diagnostic imaging and opinion. • Specialised cardiac imaging and diagnosis.	05
2		Chest: 220÷262 *(84%)*	• Undetermined chest infection.	01
3		Chest: 1200÷1400 *(85.7%)*	• Multiple chest lesions, for specialised opinion. • Neoplastic investigations. • Specialised contrast-aided imaging.	03
4		Abdomen: 90÷120 *(75%)*	• Undetermined conditions: abdominal, cardiac, cranial.	15
5		Chest: 120÷168 *(71%)*	• Contrast-aided imaging and diagnosis.	01
6		Abdomen: 70÷120 *(58%)*	• Specialised abdominal/pelvic imaging and diagnosis.	04
7		Skeletal: 80÷120 *(67%)*	• Multiple skeletal Injuries for specialised CT imaging, and orthopaedic management	04
8		Chest: 167÷241 *(69.3)*	• Specialised imaging and diagnosis. • Undetermined chest infection.	05
9		Chest: 92÷102 (90%)	• Specialised Cardiac imaging and diagnosis.	01
10		Chest:167 ÷245 *(68%)*	• Multiple neck injuries for diagnosis and orthopaedic management.	02
11		Chest: 89÷100 (89%)	• Contrast-aided imaging. • Specialised CT imaging and diagnosis.	07

Sourced from radiology/hospital registers/records, reports, and provincial map of healthcare facilities:

- Referral distances between referral district hospitals and second referral hospital, within the province, in kilometres: 73, 120, 180, 189, 200, 310, and 394.
- Based on map of Western province healthcare facilities, patients covered initial varied distances from homes through referring health centres/posts to first referral hospitals before reaching the second referral hospital under varied transport terrains.
- For transportation convenience, referrals from first referral hospital to second referral hospital in a neighbouring province occurred.
- Referral distance from the provincial second referral hospital to the nearest third referral hospitals, outside the province, was 600 kilometres, which could be additional distance to the distance covered up to the second referral hospital if the patient is re-referred.
- Whilst the cited distances represent one route, referrals would constitute doubling distances for return trips.
- The minimum single referral costs for transport and lodging varied depending on distances, examinations and associated durations involved, such as: USD 20, 28, 40, 50, 80, 250, or 500 – *converted to United States Dollar.*

APPENDIX 20: Clinical Application Evaluation Questionnaire

FRONTLINE RADIOGRAPHIC HUMAN CAPITAL DEVELOPMENT – a Case of Zambia and Way Forward

Client Satisfaction Questionnaire following Pilot Training of Pattern Recognition and Reporting for Radiographers (DP3R); as feedback from both (1) internal and (2) external clients of the service, (1) clinicians and (2) patients, respectively.

Client Satisfaction Survey in Chest X-ray Examinations Date: .....

Age *(if child):* .....Gender: ..... Area Address: .....

Occupation: .....

Previous Chest X-ray Examination - tick Y (Yes/No).
Current Radiological Examination: .....

Technical Inclusion Criteria – Confirm, by ticking [Y] in the adjacent box, the following criteria:

- Chest x-ray service with radiological diagnostic report [ ]
- Patient with history of previous x-ray services [ ]

The information sheet is provided for your reference. This questionnaire marks the last part of our investigation. You are kindly requested to respond to the questions below as objectively as possible:	**Response:**
1. State your single main expectation from the chest x-ray services.	
2. Suggest your single recommendation to improve the chest x-ray services.	

3. Provide your rating on the recent diagnostic reports accompanying the chest x-ray image: - ***Tick rating*** Y	Very Dissatisfied	Dissatisfied	Not sure	Satisfied	Very Satisfied
	1	2	3	4	5

4. State the most satisfying part of the chest x-ray examination service offered to you.	
5. State the least satisfying part of the chest x-ray examination service offered to you.	
6. Kindly offer up to two other opinions towards improving chest x-ray services.	1. 2.

Thank you very much for your participation.

(Signed)

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