COMPLIANCE TO RADIATION SAFETY STANDARDS BY RADIOGRAPHERS AND DENTAL PROFESSIONALS IN WATERBERG DISTRICT HOSPITALS: LIMPOPO PROVINCE

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COMPLIANCE TO RADIATION SAFETY STANDARDS BY RADIOGRAPHERS AND DENTAL PROFESSIONALS IN WATERBERG DISTRICT HOSPITALS: LIMPOPO PROVINCE

by

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DEDICATION

This mini-dissertation is in memory of my dearly departed father who strongly believed in the education of an African child.

D E C L A R A T I O N

I **MODIBA RESHOKETSWE MOKGADI** declare that **COMPLIANCE TO RADIATION SAFETY STANDARDS BY RADIOGRAPHERS AND DENTAL PROFESSIONALS IN WATERBERG DISTRICT HOSPITALS: LIMPOPO PROVINCE** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references and that this work has not been submitted before any other degree at any institution.

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Reshoketswe Mokgadi Modiba Date

Student Number

[redacted]

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- The Limpopo Provincial Department of Health and Social Development, for giving me permission to conduct the study.

ABSTRACT

This dissertation reports on findings from a qualitative research that sought to investigate adherence and compliance to radiation safety protocols by radiographers and dental professionals in the Waterberg District. The study also sought to determine the knowledge the participants had on the chronic ill-effects of occupational exposure to radiation, safety protocols and their professional experience in dealing with occupational exposure to radiation.

Altogether 60 participants from 8 health institutions in the Waterberg district took part in the study. They were compromised of males and females with ages ranging from 22-60 years. The response rate was 75% (n=45/60).

The empirical data of the study shows a consistent yet disconcerting pattern among practitioners about safety compliance, safety protocols and their understanding of long term effect of occupational exposure to radiation. Despite their impressive knowledge of X-rays being a source of ionizing radiation, the level of their understanding of ill-effects thereof was of great concern. The general failure by both professionals in complying with the most basic safety protocols is worrisome. In a nutshell, yet some of the practitioners were found to be greatly exposed to radiation, their daily practices were found not consistent with procedures dictated by the guidelines on the use of medical X-ray equipment. Overall, only 59% of radiographers always wore their dosimeters, a basic monitoring and protective tool to measure their radiation exposure. In the study, only 38% of the dentists were found to be compliant and overwhelmingly alluded this to their employers being unable to supply them with crucial protective clothing, a finding that the researcher cannot dispute as indicated in the responses by the two groups.

The failure of the employer in enforcing monitoring and assuring safety to the employees, patients and the general public emerged from this study. Various non-compliance patterns could be attributed to the participants and others to the employer. Protocols as clearly stipulated in R1332 of Hazardous Substance Act 15 of 1973 and other guidelines are not adhered to.

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DEFINITION OF CONCEPTS

Radiation	It is the process by which energy is emitted in the form of particles (e.g. atoms, electrons, ions, etc.) or waves (e.g. light and sound) from one body to another without a medium in between (Morris, 1992)
Radiation exposure	It refers to the occupational exposure to radiation of health workers (who work with X-ray machines) in the X-ray and Dental Departments.
Electromagnetic radiation	Refers to the energy in the form of waves or rays which are emitted when electrons return to their original level after gaining energy and moving to a higher energy level. The major source, thereof, is the sun (Hinwood, 1993).
ALARA	(As Low As Reasonably Achievable) refers to a guiding and ethical principle in terms of reducing radiation exposure that patients can be subjected to.
Radiation safety	Refers to methods, materials and regulations used to protect personnel who handle or are exposed to radioactive materials (Morris, 1992).
Health-care professionals	**I**n this study it refers to Radiographers and Dental professionals.
Dental professionals	Refers to Dentists, Dental Therapists and Oral Hygienists.
Ionizing radiation	This is the electromagnetic radiation capable of producing ionization in substances through which it passes (e.g. X-rays, gamma rays), (Morris, 1992).
X-Ray unit	It is an electronic product that is designed, manufactured or assembled with the primary purpose of producing X-rays (Code of Practice, Directorate: Radiation Control, National Department of Health).

CHAPTER 1
ORIENTATION TO THE STUDY

1.1 INTRODUCTION

Various studies have indicated that any amount of radiation pose some risk of cancer and genetic defects (Nias, 1998; Walden & Farzaneh, 1990). Although there is a dearth of publications, both from written literature and research output on low dose levels of radiation, there seems to be a common understanding in science that chronic exposure to low level doses, e.g. doses received as occupational exposure over certain duration, are also risky. Radiation is an important concept in the medical fraternity. Its discovery has brought both beneficial and detrimental effects to human health. The beneficial effects of radiation include the use of X-rays in diagnostic medicine, but also detrimental if patients or health-care workers are repeatedly exposed to radiation. The former includes the therapeutic use of radiation in the treatment of cancer which could have intolerable ill-effects.

Radiation can either be ionizing or non-ionizing, with the former being the one that is critical. Exposure to ionizing radiation is not only from medical and occupational uses, but also from the naturally occurring radiation in the environment, typically about 88% (Walden & Farzeneh, 1990). We are all exposed to radiant energy emitted by the sun, which makes the sun a source of ionizing radiation that consists of high energy waves which can penetrate cells thereby causing damage to cells (Nias, 1998).

Hazardous effects of radiation were recognized even before the discovery of X-rays. Various studies have indicated that any amount of radiation may pose some risk of causing cancer and genetic defects. Chronic exposure to low level doses is risky even though the body is better equipped to tolerate a chronic dose than an acute dose as it gets time to repair a smaller percentage of cells at any given time (Hinwood, 1993). It is this low chronic dose that is received through occupational exposure to radiation. The risks for these effects are not directly measurable in populations of exposed workers, hence the risk value at occupational levels being estimates based on risk factors measured at high doses (Hinwood,1993). Radiation has through the advent of technology and recent disasters aroused public interest. The severity of the March 2011 Japan nuclear disaster has drawn cross-sectional comparison with the previous nuclear disasters such as the 1986 Chernobyl which was initially rated the worst.
The speed at which the cooling system was applied and all measures taken into evacuating people, blocking any leakages of electromagnetic substances, was all done with the interest of saving the

environment and most importantly avoiding exposure to the surrounding communities. The involvement of the United Nations and volunteer workforce from other countries, further demonstrates global awareness and dangers associated with radiation and nuclear exposure to humans (Tromp et al., 2011). The full effects of radiation are not direct, hence can take years to fully take effect, in terms of its impact to the environment and human health.

The radiation from mobile phones has also stimulated debate in the science fraternity with the WHO's International Agency for Research on Cancer having released its report that suggests radiation emission from mobile phones can possibly induce long-term health effects (www.wikipedia.org/wiki/mobile_phone_radiation_and_health, accessed 28 June 2011). Although results of studies on mobile phones' risks have received widespread public attention, their interpretation is not straightforward because of methodological difficulties in assessing radiofrequency fields (RF) exposure. The RFs are invisible and imperceptible and individuals cannot directly report on their exposure (Ahlbom et al.,2004), hence the importance of further studies with WHO report being the closest to proving the long term effects of mobile phone use. This is surely forcing the world not to ignore radiation exposure.

South Africa is not left out from complexities surrounding the use or exposure to radiation sources. In line with advanced technology in the medical field, radiation is used in our country for both diagnostic and therapeutic benefits. Its benefits and ill-effects are acknowledged. Hence, various legislations have been promulgated as early as 1973 to control electronic products, such as the Hazardous Substance Act of 15 of 1973. The national Department of Health has a specific division that deals with the regulation of radiation products, the Radiation Control Directorate. There are on-going studies on radiation exposure effects, even though very few on the long term occupational exposure (Nias, 1998; Walden & Farzaneh, 1990).

As seen from the discussion above there have been attempts to create legal frameworks to guide practitioners in addressing safety protocols associated with occupational exposure to radiation. However, little is actually known about everyday practices of practitioners nor their compliance practices with regard to radiation exposure. Few studies in the area of chronic exposure to low dose levels of radiation might also be contributing to the complacency that exists among health-care professionals with regard to safety protocols. This suggests that a need exists for qualitative research to take as its starting point, the complexities of compliance issues with radiation to occupational exposure to radiation.

The rationale for this study could thus be articulated as the need to establish whether there is sufficient knowledge about the harmful effects of radiation exposure and the implementation of safety protocols thereof amongst radiographers and dental professionals. It further seeks to affirm whether there are any monitoring programmes and responsible authorities that ensure that such protocols are complied with.

1.2 CONTEXT OF THE STUDY

Medical centres and hospitals in general are a major source of man-made radiation source because of the use of medical X-rays. Waterberg District Hospitals in Limpopo are no different. These health institutions have equipped X-ray and Dental Departments with intra-oral and extra-oral machines for diagnostic purposes. Health-care workers in these Departments are exposed to more radiation than an average person by virtue of their occupation. In addition, dose limits for members of the public are generally much lower than those for occupational exposure. Other machines such as CT-Scan, which emit a lot of radiation, are at the tertiary Hospital in Polokwane, where an Oncology unit is located.

Safety control protocols that aim at protecting patients, the public, operators and other staff members coming into contact with the area in which radiation equipment are utilized are what this study seeks to establish in terms of compliance. In addition, there are policies on occupational exposure of pregnant radiographers, radiologists and dental professionals (National Department of Health, Radiation Control Policy). Hence, an essential part of the radiographer's education and ethical responsibility is to be knowledgeable about radiation safety to avoid unnecessary radiation exposure (from both the primary and secondary X-ray beams) to patients, co-workers and self (Erlich et al., 1999).

Despite the above-mentioned measures, 2 institutions in the Waterberg District had their X-ray Departments closed down due to failure to adhere to radiation safety standards (Radiation Inspection Report, 2001 & 2006). At one of the institutions a Panorex X-ray machine was procured without the necessary radiation control measures being followed. The said equipment has since become obsolete (Radiation Inspection Report, 2008). Some experiences also relate to the suspension of renewal of dosimeters for health professionals, with the South African Bureau of Standards indicating the failure of X-ray users in complying. The Department ends up paying for a service that should monitor and ensure the safety of their staff but the staff does not comply. Failure by management in ensuring that Quality Assurance Tests are DONE as required is another challenge facing the Department

1.3 SAFETY CONTROL PROTOCOLS IN SOUTH AFRICA

In South Africa, the overall regulation of electronic products falls under the control of the directorate for Radiation Control within the National Department of Health (DoH). The Radiation Control is guided by the Codes of Practice of Electronic Products (Hazardous substance Act 15 of 1973). The Hazardous Substance Act of 1973 is the most important legislative document providing the framework for hazardous substance control. It ensures the issuing of licenses, appointment of inspectors or inspection of bodies, in Section 9. The Radiation Control's Code of Practice has very clear guidelines for electronic products. There are various guidelines that regulate electronic products, e.g.:

Guideline: Dental Radiography

Guideline: Design of X-ray rooms

Guideline: Personal Monitoring when a lead apron is worn

Guideline: Management of Pregnant Radiographers and other staff members

Guideline: Request for medical X-ray examinations

The Code of Practice for users of Medical X-ray equipment sets out requirements and recommendations for radiation safety associated with the use of medical diagnostic X-ray equipments. The Hazardous Substance Act 15 of 1973 and Regulations No.R1332 of 3 August 1973 governs the safe use of medical X-ray equipment in South Africa.

Regulations concerning the control of electronic products require that a premise be obtained before the commissioning and installation of X-ray equipment. The application is done through the National Department of Health and issued for specific equipment in a particular premise. A license holder may appoint a responsible person with adequate knowledge in the field of radiation protection.

Radiation Protection is clearly emphasized in the Code of Practice in the Radiation Control Directorate of the National DoH. Basic radiation protection principles are based on justification of the practice, optimization of protection by keeping the occupationally exposed doses or that of patients to as low as reasonably achievable (ALARA principle), and also limitation of individual dose and risk.

1.4 PROBLEM STATEMENT

Radiographers and Dental professionals in hospitals use radiation for diagnostic purposes. On-going reported cases of non-compliance in radiation safety protocols are a cause for concern. Hence, authorities and health-care professionals' knowledge on the effects of radiation is critical and need to be ascertained. The use and ill-effects of radiation is a subject which has not stimulated much debate among health professionals even after the closure of those affected units. It is therefore worrisome, and one wonders as to the knowledge level among radiographers and dental professionals with regard to radiation use and its ill-effects. Do the existing legislative mandates and regulations for the protection of the radiation workers and the patients in their correct form effective to enforce compliance within the field? What role should health-care professionals be playing as the main contributors of man-made exposure to radiation by virtue of working with medical X-ray equipment. According to literature, medical X-rays are the major source of man-made radiation exposure (Walden & Farzeneh, 1990).

The monthly reports that institutions get from SABS regarding the level of occupational doses radiation workers were exposed to do not seem to be of significant importance to health-care workers.

1.5 RESEARCH QUESTIONS

(1) What do radiographers and dental professionals know about ionizing radiation exposure?
(2) Do health-care professionals comply with radiation safety standards as stipulated by the National Radiation Control and Occupational and Health Safety Act?
(3) Do the designs of X-ray rooms comply with the guidelines as stipulated by the Radiation Control of the National Department of Health?

1.6 THE PURPOSE AND OBJECTIVES OF THE STUDY

The main purpose of the study is to determine the level of compliance to radiation protection protocols by health-care professionals in the Waterberg District of the Limpopo Province. The researcher seeks to establish their knowledge regarding ionizing radiation and exposure thereof. To establish whether these health-care professionals understand and practice guiding specifications such as ALARA or comply with wearing of dosimeter or even protect patients with lead aprons. To establish whether health-care professionals understand and apply radiation safety protocols and routines in their working environment as per Codes of Practice for Users of Medical X-ray Equipment, Department of Health (2002).

The objectives of the study are as follows:

(1) To determine the level of awareness with regard to long-term radiation exposure effects on health-care professionals.
(2) To investigate if X-ray and dark rooms comply with the National Radiation guidelines of the National Department of Health.
(3) To determine if health-care professionals comply with radiation safety standards

1.7 SIGNIFICANCE OF THE STUDY

The study seeks to stimulate interest among health-care workers and their employer in the Department of Health and Social Development about the importance of chronic ill-effects of radiation exposure. The closure of two X-ray Departments in the Waterberg District by the National Radiation Directorate raised critical issues of non-compliance with radiation safety protocols. The findings of this study will assist the Department to review its monitoring and compliance to radiation safety protocols.

1.8 CONCLUSION

This chapter sought to introduce the motivation for the study, the purpose and objectives thereof, the significance of medical X-ray equipment as a major source of man-made ionizing radiation and the role of health-care professionals thereof. It is acknowledged that various legislations and protocols exist that govern the use of medical X-rays but the compliance and understanding remains a concern.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

The hazardous effects of radiation were recognized shortly after the discovery of X-rays in 1895 by Roentgen (Walden & Farzaneh, 1990). The detrimental effects of ionizing radiation were recognized earlier on, making the history of radiation hazards and protection to be as long as that of X-rays. This discovery later led to the introduction of a bill in the New Jersey legislature preventing the use of X-ray lenses in opera glasses (Walden & Farzaneh, 1990).

Radiation safety standards in the United States were formulated in 1929 with an organization called National Council on Radiation Protection and Measurement, being assigned the responsibility to formulate guidelines and recommendations on radiation protection and measurements (Walden & Farzaneh, 1990).

In an article by Mupparapu (2005), the Dental X-ray guidelines from the National Council on Radiation Protection were discussed, whereby radiation exposure dose limits for occupational and non-occupational exposure to radiation protection for operators, patients and the public were addressed. It was found that equipment design can play an important role in radiation protection. According to published data, the average dental occupational exposures are generally a small fraction and far less than that of most radiographers.

Hutchinson et al. (1999) study found that since 1950, X-ray equipment in the state of Western Australia has been inspected by authorized officers from the regulatory body responsible for the administration of State's Radiation Safety Act. Data from inspections demonstrated that regular compliance and performance checks are essential in order to ensure proper performance and minimize unnecessary patient and operator exposure.

Radiotherapy, as a treatment procedure has proven track record in health administration, however the procedure equally has harmful effects on human health. Almost 40 million people are diagnosed with cancer each year; hence, are likely to receive radiotherapy (Donaldson, 2007). The hazardous nature of radiation led to an extensive framework of protocols, standards, and legislation to protect both patients and healthcare workers. The World Health Organization (WHO) World Alliance for Patient Safety has taken the challenge to make radiotherapy safer focusing on the two questions:

(i) Whether standardized safety interventions that can reliably and consistently reduce the risk of patients being harmed by radiation can be developed?

(ii) Whether lessons from previous errors can be translated into safer health care for patients everywhere?

This is justly so, because despite global efforts to minimize harm from radiotherapy, cases whereby patients have been harmed were reported (Donaldson, 2007).

2.2 IONIZING RADIATION HAZARDS/ACCIDENTS

A nuclear and radiation accident is defined by the United Nations International Atomic Energy Agency as an event that has led to significant consequences to people, the environment and the facility.

2.2.1 Chernobyl Nuclear Accident

This was one of the biggest nuclear accidents ever experienced that exposed people to ionizing radiation. The Chernobyl nuclear power plant accident occurred on the 26th of April 1986 in the Soviet Union and clearly showed the ill-effects of radiation on human health as published in the WHO (1995) report. The report links sharp increase in cancer cases in the Soviet Union with the after effects of the nuclear disaster. International radiation standards, strategies for improving the nuclear safety, emergency response procedures and mitigation of consequences were revised after the incident (Chernobyl Nuclear Accident Report, WHO, 1995). Our general understanding of the health effects of ionizing radiation is improving due to continuous research and the knowledge gained from studies carried out on Chernobyl populations (Health effects of the Chernobyl accident, WHO Report, April 2011).

2.2.2 Japan Earthquake and Tsunami

The 2011 Japanese earthquake was referred to as the Fukushima Daiichi nuclear disaster because of the destruction caused by the Tsunami and earthquake to the Japan nuclear plant. It was the largest earthquake ever recorded in Japan's history and only second to the Chernobyl nuclear disaster-resulting in a radiation threat. The earthquake hit the nuclear plant and radioactive substances started leaking (Onomitsu & Hirokawa, 2011:20). A massive operation of cooling the plant was engaged with the intention of reducing the radiation levels. People were evacuated to avoid exposure to radiation that could lead to harmful health effects (later in life). Japan also experienced the Hiroshima bombings towards the end of World War II. A prospective cohort study was done among atomic bomb survivors, comprising of children whose parents were in the proximity of the nuclear accident, those who moved in later and those who were around but far from the exposure. It was found that 13 years later, results of infant deformities and cancer before the children turned 20 years were detected (Young & Yalow, 1995).

2.2.3 Radioactive Isotopes

In recent times the use of radioactive isotopes in military nuclear weapons at nuclear power stations has aroused greater public interest. A Swiss citizen was arrested in South Africa for making uranium parts which could be used for weapons of mass destruction (Mapiloko, 2008:8). The damage that these nuclear weapons can do is a cause for concern worldwide. A key South African nuclear facility (Pelindaba) was immediately shutdown when dangerous gases started leaking. The 'Coalition Against Nuclear Energy' in South Africa was deeply concerned about the leakage as they suspected iodine leakage which was responsible for the severe illnesses in the Chernobyl disaster (Swart, 2009). This is an indication of the effect the Chernobyl disaster has had in terms of long term ill-effects of exposure to these radioactive elements, which has sensitized governments to the dangers of these radioactive isotopes that could expose the population to radiation exposure.

2.3 RADIATION AND HEALTH

2.3.1 Chronic Low Dose Radiation

The use of ionizing radiation for therapeutic and diagnostic purposes is considered 'peaceful', yet this 'peaceful use' has carcinogenic and mutagenic effects to human health, even with low doses over an extended time. This area has not been thoroughly researched. However, it has been widely acknowledged that any amount of radiation is a risk which can cause cancer and genetic defects. As a result, regulatory bodies have come up with stringent measures of regulating radiation exposure. The challenge is that biological effects of very low doses of radiation are more difficult to measure and by far, only higher doses of radiation have been studied (Nias, 1998).

2.3.2 Radiation and Pregnant Women

According to a study by Sternheim and Kane (1991), it was found that children whose mothers received pelvic X-rays while pregnant had a 30-40% chance of suffering from cancer. Hence, legislations and protocols on how to protect women of child-bearing age or pregnant women from radiation were developed. People working with radioactive materials and X-rays are required to wear film badges. It was recommended that the badge be worn at pelvic level close to reproductive organs in order to measure radiation exposure, making this a very important monitoring device (Jaros & Breuer, 1982).

2.3.3 Radiation Workforce

In the early days of diagnostic radiology, physicians were not as careful as they are today and exposed their hands, in such way that many suffered radiation injuries to their hands, later developing skin cancer later (Benton, 1982). In 1969, in the Union of Soviet Socialist Republic, a law was enacted that established the safety standards with respect to production, processing, application, storage and transport of natural or artificial radioactive substance and other sources of ionizing radiation. In the United States, Radiation Control for Health and Safety Act of 1968 authorized the formulation of the standards to control the emission of radiation (Benton, 1982).

2.4 RADIATION CONTROL MEASURES IN SOUTH AFRICA

Until 3 August 1973, when regulations concerning the control of electronic products were promulgated in terms of the Hazardous Substances Act (Act 15 of 1973), electronic products capable of emitting ionizing radiation have been freely available to the public and could be used by anybody on any premises. These regulations forbid the use of any electronic product generating X-rays or other ionizing beams, electrons, neutrons or other particle radiation, unless such equipment and premises are licensed. In terms of these regulations, powers were granted to the Director-General of National Health to perform inspections at x-ray facilities. The objective of these regulations was to ensure that the patient, the operator and general public are only exposed to ionizing radiation if such procedure is justified, optimized and the individual dose minimized. For almost 15 years, the licensing and inspection of facilities have formed the backbone of radiation control in South Africa. This type of licensing procedure has its limitations, and consequently the Hazardous Substances Act (Act 15 of 1973) was amended to make provision for regulations to be compiled that would include the control over sale. These regulations were published in the Government Gazette of 14 April 1989. To ensure effective control, licensing and inspections are based on internationally recognized standards, which are amended for local conditions.

In South Africa, the National Radiation Control, SABS, the Nuclear Energy Corporation of South Africa, together with other various bodies with interest in radiation have regulations that control the amount of radiation exposure permissible. All machinery that is a source of radiation is registered with the

Radiation Control before they could be operated. This is one of the few requirements in terms of compliance that is expected from health professionals dealing with radiation equipments and the relevant authorities thereof. Radiation regulations are covered under Hazardous Substance Act 15 of 1973. Other important legislations are the Occupational Health and Safety Act, National Nuclear Regulator Act of 1999 and also the National Council of Radiation Protection and Measurements Report.

2.5 RADIATION SAFETY STANDARDS

In various studies, scientists do concur with the fact that complying with radiation safety standards drastically minimizes the additional exposure or occupational exposure to radiation for health workers (New Jersey Dental School, 2005, Hutchinson et al., 1999). This was also confirmed by a study of staff members' safety with regard to ionization radiation in a major trauma center over a 19 month period by Tan and Van Every (2005). It indicated that wearing lead aprons provided adequate protection, which was found to be below the recommended occupational dose.

The challenge as shown by various other studies was lack of knowledge on long term effects of radiation exposure or ignorance thereof by healthcare workers. In a study by Nakfoor and Brooks of Michigan School of Dentistry (1992), about compliance of Michigan dentists with radiography safety standards, 73% did not comply with the type of film speed or collimator recommended, while the use of cervical collars (critical in protecting the thyroid) was complied by only 49% of dentists. In almost a similar study of dental radiography by Rush & Thompson (2007), it was found that the technique and equipment have a profound effect on the radiation dose exposed to the patient. The use of a combination of paralleling technique and rectangular collimator was compared with the use of 'bisecting the angle technique' and a circular collimator during intra-oral examination of the upper and lower teeth at the thyroid gland position. It was found that the first combination resulted in reduced radiation dose, this low dose combination within the dental practices remains limited and therefore continued awareness and acceptance of radiation hazards need to be addressed.

Information on health risks associated with ionizing radiation should be central in the training of all physicians and other medical personnel working in areas of radiation exposure (Erlich et al., 1999). Despite this recommendation by radiation bodies, clinicians involved in the use of ionizing radiation, are not familiar with radiation exposure doses they and their patients are subjected to (Smith & Rivers, 2007). Erlich and colleagues conducted a study on the measure of radiation exposure in cardiac imaging and the impact of case complexity; they noted that, when recommending a cardiac imaging procedure, few clinicians are aware of the level of exposure involved

2.6 RADIATION SOURCES

The advent of technology has increased curiosity in patients. In South Africa, there has been a recorded case of electromagnetic hypersensitivity, whereby the victim/patient had to isolate herself away from any radiation sources, such as television sets, cellphones, etc. According to the Electromagnetic Radiation Research Foundation of South Africa there are many people who experience this (Davids N, 2011). The WHO has released the results on mobile phone radiation study by the International Agency for Research on Cancer, that classified mobile phone radiation on the IARC (International Agency for Research on Cancer) scale into group 2B, implying possible carcinogenic effects (www.wikepidia.org, accessed 28 June 2011). Cellphones networks go as far as advising their customers to reduce exposure, while other service providers still insist on getting conclusive evidence. Mobile phone radiation is considered similar to long term exposure to low dose radiation. The (WHO) study has not ruled out the possibility of cellphones being harmful but also indicated that further studies are necessary. This study formed the basis for the lobbying of legislation by the Electromagnetic Radiation Research Foundation of South Africa, to protect cellular phone users as this is not covered under the control of electronic products legislations. Even though the WHO results were not conclusive, but indicates to the need for further research on the effects of the long term exposure to mobile phone radiation.

Various research investigations on the knowledge patients have regarding radiation safety protocols show that in some instances patients have been found oblivious to the facts, either uninformed or completely paranoid about radiation (Lockwood et al., 2007). In the study above, it was found that physicians sometimes struggle to assure patients because of their reluctance to acknowledge radiation's harmful effects. Health professionals not complying with standard radiation protocols, e.g. not applying the 'ALARA' principle, using CT with discretion (as it accounts for two thirds of cumulative patient dose from diagnostic procedures), could potentially lead to litigations by patients. Medical physicists can provide specific information about radiation doses of common diagnostic procedures (Lockwood et al., 2007).

2.7 RADIATION AND HEALTH-CARE PROFESSIONALS

It seems clear that despite the small but definite risk to patients' health, investigations on radiation exposure are acceptable and are fundamental in medical practice. The effects of radiation exposure and its safety precautions are key. Shiralkar et al. (2003), investigated health professionals' views on radiation doses received by patients when they undergo commonly requested radiological investigations. Few of the health professionals knew the dose levels of radiation that their patients were exposed to during radiological investigations. Although the study involved doctors from two hospitals in different regions, it was apparent that most doctors had no idea as to the amount of radiation received by patients undergoing commonly requested radiological investigations. Most patients entering the hospital will undergo one X-ray investigation. Although it is acknowledged by both the medical professionals and the general public that radiological investigations are valuable, Shiralkar et al. (2003) found that they still represent a potential risk to health through exposure to ionizing radiation.

The above sentiments were echoed in the UK's first study ever that endeavored to establish whether medical students had sufficient knowledge on radiation protection prior to graduation. Singh et al. (2008) used experts comprising of radiologists and clinicians to undertake a study among newly qualified medical officers. Although they took cognisance of the fact that most exposures to ionizing radiation occur within Radiology Departments, it was medical officers who request these radiological examinations, which then became imperative for both those in radiology departments and medical officers to have the same understanding of justifiable subjection of patients to radiation exposure. In their study they recommended for the development of an undergraduate program or course on radiation protection for medical officers. They recommended for the promulgation of relevant legislation that would regulate radiation exposure.

In a study by Chie et al. (2002), intracoronary radiotherapy procedures, radiation exposure levels and safety of medical personnel were examined. It was argued that the method of intracoronary radiotherapy currently adopted and which was the basis of their trial, is safe with respect to radiation protection.

In another study by Zhou et al. (2010) among medical students and interns, the level of awareness of ionizing radiation in these groups was assessed. The results acknowledged that even though the two groups had received some form of education on ionizing radiation, they all indicated that continuous training on the job in the form of lectures, tutorials and workshops will be appreciated. This was a result of the failure of the two groups in indicating the radiation exposure doses from common diagnostic imaging procedures and the significance of subjecting their patients to such radiation.

The attitude and knowledge of European urology resident doctors concerning ionizing radiation found that the protection of staff was poorly co-ordinated with under usage of protective gear. The failure of the urology resident doctors in using radiation protection measures was of concern to the authors (Soylemez et al.2013).

In the study of Portuguese students' knowledge on radiation physics, Rego & Peralta (2006) made interesting findings regarding the lack of knowledge by students in differentiating between ionizing and non-ionizing radiation. The nature and characteristics of radiation were not clearly displayed, with lack of understanding on the relation between risk and radiation type further observed.

Over the years several studies in different countries have investigated perceptions, knowledge on radiation and its ill-effects among students, health professionals and mostly point to a poor understanding of radiation issues.

The key area of concern as indicated in the motivation for this study is compliance to radiation safety standards by health-care professionals. The implicit assumption is the underlying belief that deeper understanding of radiation related risks, will in some ways contribute to increased care and compliance.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter outlines the research methods used in this study. The chapter will explore procedures for data collection in the study and how the data was analyzed. The limitations of the study will be briefly addressed.

This study sought to determine the compliance to radiation protection protocols by radiographers and dental professionals, their knowledge regarding radiation and its ill effects. The study was thus interested in establishing whether these health-care professionals are familiar with ionizing radiation exposure, and its health effects thereof The idea was to find out the level of awareness or knowledge among these professionals regarding chronic radiation exposure effects in their workplace. In particular, compliance with the existing radiation safety protocols as promulgated in the Hazardous Substance Act of 1993, Occupational Health and Safety Act of 1993 and also in the code of practice for users of Medical X-ray Equipment by Radiation Control Directorate – National Department of Health. The study seeks to ascertain whether these health-care professionals understand their roles and responsibilities as professionals handling radiation equipment.

3.2 STUDY DESIGN

A quantitative descriptive study methodology was the preferred one due to its rigid style of categorizing responses to questions and having the numerical data analyzed statistically. Its cost effectiveness added to its preference and the questionnaire was the tool of choice. Cresswell (1994) indicates that careful design of data collection tool is critical in an attempt to eliminate bias from the study, and so careful consideration was given in designing the questionnaire.

3.3 STUDY POPULATION

The study was conducted among the eight hospitals in the Waterberg District of the Limpopo Province, namely Mokopane Regional, Voortrekker, George Masebe, F.H Odendaal, Warmbath, Thabazimbi, Ellisras and Witpoort hospitals. The target population was male and female radiographers and dental professionals in these institutions. The population consisted of 25 Radiographers, 21 Dentists, 6 Oral Hygienists and 8 Dental Therapists. These health professionals work with both intra-oral and extra-oral X-ray machines. There are no CT-Scans or MRI done in the district, all referred to the Polokwane tertiary hospital.

3.4 SAMPLING

Sampling in research is advantageous as it allows for inferences about an unknown population to be drawn from a small but well chosen group of persons or objects. The important issue in sampling is to determine the most adequate size of the sample which is representative of the whole population (Bless & Higson-Smith, 1995). The use of Morgan & Krejcie (1994) guidelines made selection of the sample size much easier and wholly representative. The guidelines indicated that for a population of 60, the sample should be 52. However, in this study, the whole population served as a sample due to its small size to ensure generalizability of the findings.

3.5 DATA COLLECTION

Creswell (1994) indicates that careful design of data collection is critical and can eliminate bias from research. Quantitative studies emphasize the measurement and analysis of causal relationships between variables, not processes contrary to qualitative research that seeks to answer questions that stress how social experience is created and given meaning (Norman & Linclon, 2003).
The questionnaires were hand delivered to all Waterberg health institutions. The standard protocol when going into the institutions is to report at the office of the Chief Executive Officer who will then direct the researcher to managers of the relevant sections after having produced the necessary documents.

3.5.1 The Questionnaire
In most studies that have been reviewed in this study, the questionnaire was the most preferable tool in trying to determine either the knowledge of health-care professionals or patients pertaining to radiation safety protocols or radiation exposure effects. Although questionnaires could limit the amount of information one can find, they can also be designed to address open/closed-ended type of questions. The questionnaire technique was therefore the most appropriate in this study because of being relatively economical in obtaining information from the subjects by providing them with the same questions (McMillan & Schumacher, 2006*)*. It is the most direct, cost effective research tool that allows

participants to express their opinions through open-ended questions. Questions on compliance to radiation protection protocols by health-care worker were generated from the research questions. The questionnaire also had open-ended questions which allowed participants to expand on certain questions relating to the objectives of the study. Although observing the participants in their workplace would have given more insights into their operational practices, it was not feasible due to the geographical locations between the researcher and the hospitals where research informants practised. The questionnaire was developed in consultation with a statistician and questions were based on the objectives to be achieved in this study.

The format of the questionnaire that was administered to the study participants comprised of the first part that dealt with demographic questions regarding gender, age, level of education, designation and period that one has been practicing in the profession. The second part covered questions regarding knowledge about radiation, the third part about the ill effects of radiation exposure and the fourth part was organized as a series of statements, and participants were asked to express their opinion on a 4-point scale about compliance to radiation safety protocols. The last part was open-ended questions that probed further about radiation safety protocols and the risks associated with radiation exposure whereby the participants had to explain.

3.5.2 Development of the Questionnaire

Although there is a limited research output on chronic low dose levels of radiation exposure (Nias, 1998), or the knowledge of this among health professionals, there are several studies that have attempted to highlight lack of knowledge or awareness about this topic. Various studies have in the past indicated that any amount of radiation may pose some risk of cancer and genetic defects (Nias, 1998; Walden & Farzanel, 1990). Sources from the literature have been used as references to draw up the questionnaire. The statistician was consulted to give technical input and discussions ranged from generating and conceptualizing clearer set of research questions.

The issue of bias and limitations of the tool was also discussed that resulted in a part of open ended type of questions being included. Parts of the questions regarding knowledge were reconstructed from a study of Portuguese students' knowledge on radiation physics by Rego & Peralta, (2006). In a study by Nakfoor and Brooks of Michigan School of Dentistry (1992) on compliance of Michigan dentists with radiography safety standards, a questionnaire was the preferred research tool and was able to address the research questions. As a reference to the current study, few questions were adopted as they were deemed relevant to this study.

3.5.3 Pilot Study

A pilot study was conducted in the Capricorn District Hospitals, among the subjects similar to those that were going to be used in the study. The questionnaires for the pilot study were hand delivered to research subjects. There were comments made by the pilot participants regarding clarity about some questions and the manner in which they responded to the open-ended questions necessitated a review. The results from the pilot study enabled the researcher to detect areas requiring further improvement, and to further detect areas of clarity and precision in research questions. As a result, the following changes were effected to make the questionnaire clearer:

- Years of service was left open for participants to fill in the years, initially the years were grouped together for participants to select
- Open-ended question 5 was re-structured to give options so that participants can be able to explain further and give reasons

3.5.4 Response Rate

In retrospect the communication route through the supervisors could have contributed to the failure to getting a 100% response rate. They might not have returned the questionnaire as a sign of dissatisfaction to their supervisors or showing a way of not being obligated to participate. The study took place in a period of the industrial action that was going on among civil servants throughout the country over wage negotiations (Xaba et al., 2010:2). Out of the sixty who participated, 45 responded; all darkroom operators excused themselves from participation raising concerns regarding their understanding of the whole process and also indicated it is above their level. Three filled questionnaires were misplaced and the rest did not respond. Seventeen radiographers, 16 Dentists, 6 Dental therapists and 6 Oral hygienists responded satisfactorily.

3.5.5 Data Collection Procedures

The process of data collection is guided by the principles outlined in the conduction of research in the institution. A request for the study was submitted to the University of Limpopo’s Ethic**s** and Senior Degree Committee for approval. With the university approval an application was made to the Department of Health and Social Department’s Ethics Committee. After receiving the permission from the Department a letter was written to respective institutions in Waterberg District, attaching the approval and requesting for date and time to conduct the study amongst their staff. Questionnaires were hand delivered and participants engaged, they were given the official letter requesting their participation and told that it is a voluntary process from which they can withdraw at any time they feel uncomfortable. The confidentiality of information that they will be sharing was ensured.

Sequence of Activities

Details of the data collection procedures are presented in Figure 3.1 below

Figure 3.1: Data Collection Procedures

3.6 DATA ANALYSIS

Data analysis entails the procedures followed in interpreting data from the respondents. In this study the SPSS (Statistical Product Service Solutions) was used to analyze data. Descriptive statistics of frequencies mean and standard deviations were displayed. In the analysis of variables, ANOVA was used. Data had to be constructed into a variable adaptable SPPS interpretation. Coding for close ended questions was done. The open-ended questions were also coded (see Annexure 4), taking careful consideration into achieving inter-coder reliability and resulting in a standardized coding.

3.6.1 Reliability

Bless & Higson-Smith (1995) adequately defined reliability of measurement as the degree to which an instrument produces equivalent results for repeated trials. They further indicate that an instrument which produces different scores every time it is used to measure an unchanging value has low reliability and can therefore not be depended upon to produce an accurate measurement. The pilot study was used and has shown consistency in the results making this study reliable.

3.6.2 Validity

This explains the degree to which scientific explanations of phenomenon match reality (McMillan & Schumacher, 2006). Validity asks questions about whether an instrument is measuring what it is supposed to measure. Data collected in this study can be tested for validity. The pilot study has already indicated some degree of validity.

3.7 LIMITATIONS OF THE STUDY

The significant limitation of the study was being unable to observe or even monitor what the participants have indicated in the questionnaire as daily routine or standard practices. It is acknowledged that the questionnaire might not have been sufficient to address the key questions in depth because of the inability to probe further, but the open-ended portion complemented this shortfall. Consideration was also taken to the fact that the study will be done during official working hours, and therefore would not want to cause disruptions or take participants off work for a long time. The study lacks triangulation; i.e., neither interviews nor observations were done. Reports on X-ray departments that did not comply were analyzed, and a few available annual results from the Quality Assurance Tests done by Radiation Directorate of the National Department of Health were also studied.

3.8 ETHICAL CONSIDERATIONS

Ethical considerations associated with research are largely aimed at protecting research participants from any harm associated with their involvement in the research (Hansen, 2006). Letters requesting for consent to conduct the study in institutions were written to the University Ethics Committee and the Department's Ethics Committee (See Annexures 5 & 6), and the approval attached to letters written to the Chief Executive Officers of the institutions. Participants were told that this is a voluntary study, and the objectives and relevance to their workplace explained. They were assured of confidentiality to all the information they will be providing.

3.9 CONCLUSION

The research methodology used got 75% response from the participants. The tested tool which was initially piloted assisted in straightening out certain questions and ensuring clarity. The inclusion of the open ended questions allowed for participants to be able to give more information. Hand delivering and collecting the tool also assisted in getting maximum participation. The limitations observed in this study allows for future research into similar or related topics.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 INTRODUCTION

This Chapter presents the results and analysis of the responses by participants. The questionnaire was designed in such a way that it addressed the research questions. The questions attempted to find out the level of awareness with regard to long term radiation exposure effects and compliance to radiation safety protocols by radiographers and dental professionals. It also sought to check if X-ray rooms and dark room operators comply with the National Radiation Directorate guidelines.

Different categories of questions were asked with the aim of addressing the above and were grouped as follows:

- Questions addressing issues around demographics
- Questions regarding knowledge about radiation and ill-effects of radiation exposure
- Compliance to radiation safety protocols and the last part was
- Open-ended questions to enable participants to explain further regarding various radiation safety protocols in their institutions

The results were analyzed using SPPS methods and presented using frequency tables and graphs. For better clarity on interpretations of graphs, results on the degree of agreement (Figures 4.4 & 4.5) were collapsed into a single category (i.e. agree combined with strongly agree and disagree combined with strongly disagree). This practice is most suitable for small samples (McHall, 2001).

4.2 DEMOGRAPHICS

The first section (sub-questions 1.1-1.5) asked participants to present their demographic data in terms of gender, age, level of education, length of service and designation.

Table 4.1 below illustrates the details of the participants.

Table 4.1 Details of participants in the study

		Number of participants (%)
Gender	Male	14(31)
	Female	30(67)
Level of education	Grade 12 plus Diploma	11(24)
	Degree	30(67)
	Post Graduate	4(9)
Length of service	1 – 5 years	26(58)
	6 – 10 years	7(16)
	11 – 15 years	4(9)
	16 – 20 years	2(4)
	21 years and over	2(4)
Designation	Radiographers	17(37)
	Dentists	16(36)
	Oral Hygienists (OH)	6(13)
	Dental Therapist (DT)	6(13)
Age	Less than 30 years	28(62)
	30 years and over	15(33)
Total		45(100)

The total number of participants from the various Waterberg hospitals was 45. They consisted of Radiographers and Dental Professionals (Oral Hygienists, Dental Therapists and Dentists) of ages ranging from 22 to 60 years. The Table shows that the majority (67%) of the participants in the study were females.

It is also apparent from the table that Radiographers (37%) are in the majority, which was understandable as for them, taking X-rays is their key function whereas for dental professionals, it is just one of their special investigative tool. The Table also shows that most of the participants (67%) hold at least a Bachelors Degree and that 58% of participants had a short duration of service (1-5 years).

4.3 KNOWLEDGE ON RADIATION AND ILL-EFFECTS OF RADIATION EXPOSURE

The second section (Questions 2 & 3) asked participants questions to establish their knowledge about radiation and its ill-effects. Figure 4.1 below indicates the responses on whether ultraviolet rays are a form of ionizing radiation in an attempt to establish their understanding of ionizing radiation.

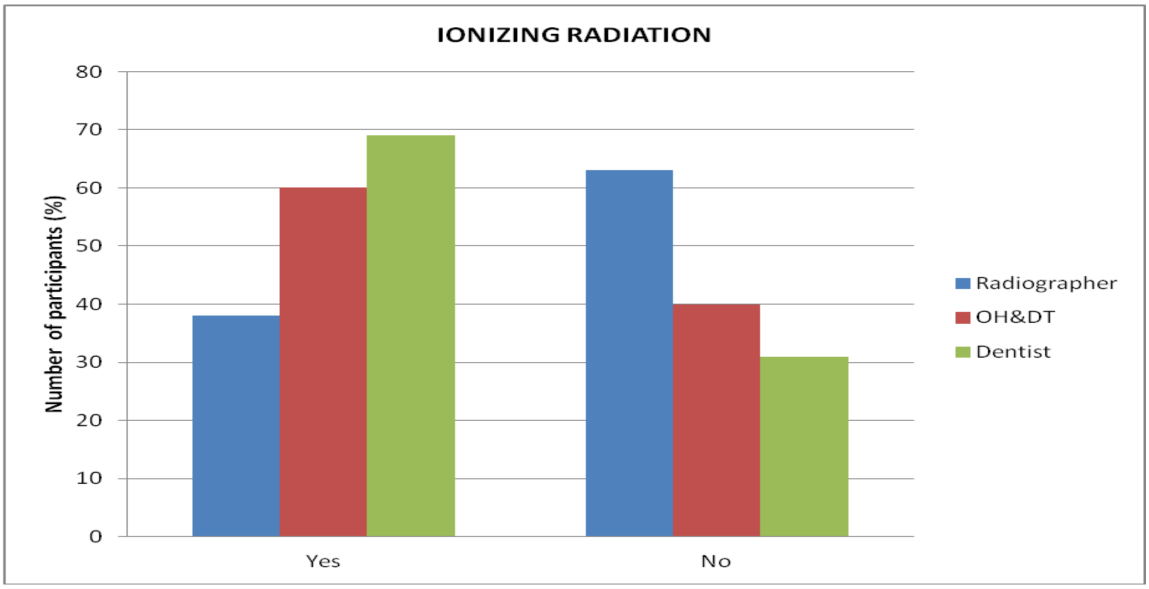
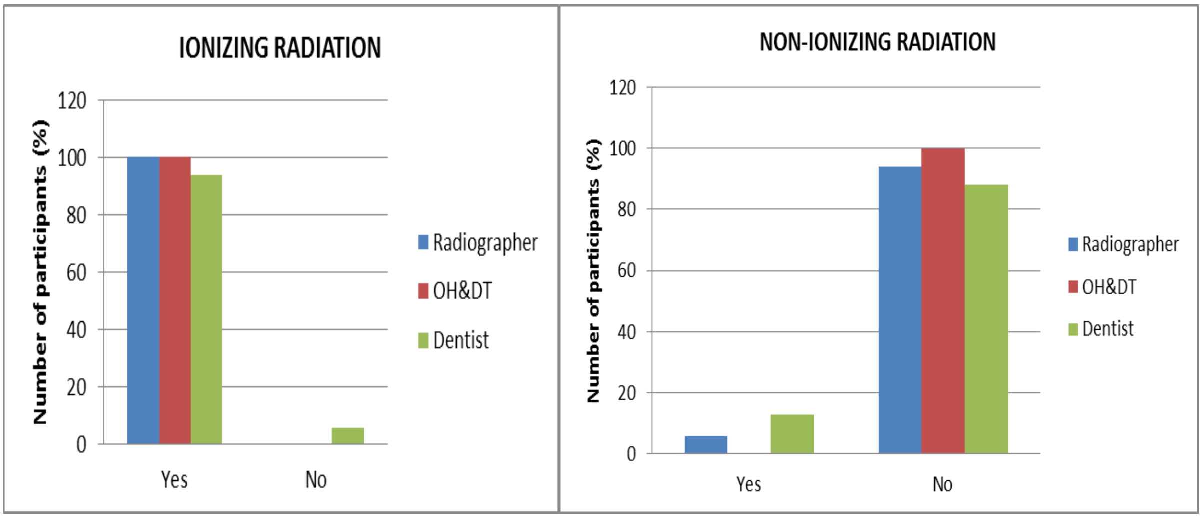


Figure 4.1 Distribution of responses on UV Rays being a form of ionizing radiation

The figure shows that radiographers (63%) do not know that UV Rays are a form of ionizing radiation, as opposed to dental professionals who had an idea (Dentists-69%, OH & DT-60%). It was rather puzzling that they missed such a critical and most talked about issue with public interest. Sun screens protect people from UV Rays from the sun which cause skin cancer. This is a widely debated issue in the media. It is a well known and commercialized phenomenon (Walden & Farzeneh, 1990). The advocacy around the use of sun protection lotion with maximum Sun Protection Factor (SPF), wearing of wide rimmed hats and just avoiding direct exposure to the sun are done as part of raising awareness about skin cancer.

Figure 4.2 below presents participants' responses on whether their X-ray equipment utilize ionizing or non- ionizing.



(a) Ionizing (b) Non-ionizing

Figure 4.2 shows the distribution of responses on the type of radiation utilized by participants' equipment as either (a) ionizing radiation or (b) non-ionizing radiation

The figure revealed an impressive indication of a good understanding of x-rays being a source of ionizing radiation by the majority of respondents (100% for both radiographers, OH&DT and 95% of Dentists) all agreeing with the statement. Figure 4.2 (b) further affirms their understanding by their responses (94% Radiographers, 100% OH&DT and 95% Dentists) that X-ray equipment used in their setting is not a source of non-ionizing radiation.

Figure 4.3 indicates the participants' responses on whether intra-oral X-rays are done in their institution.

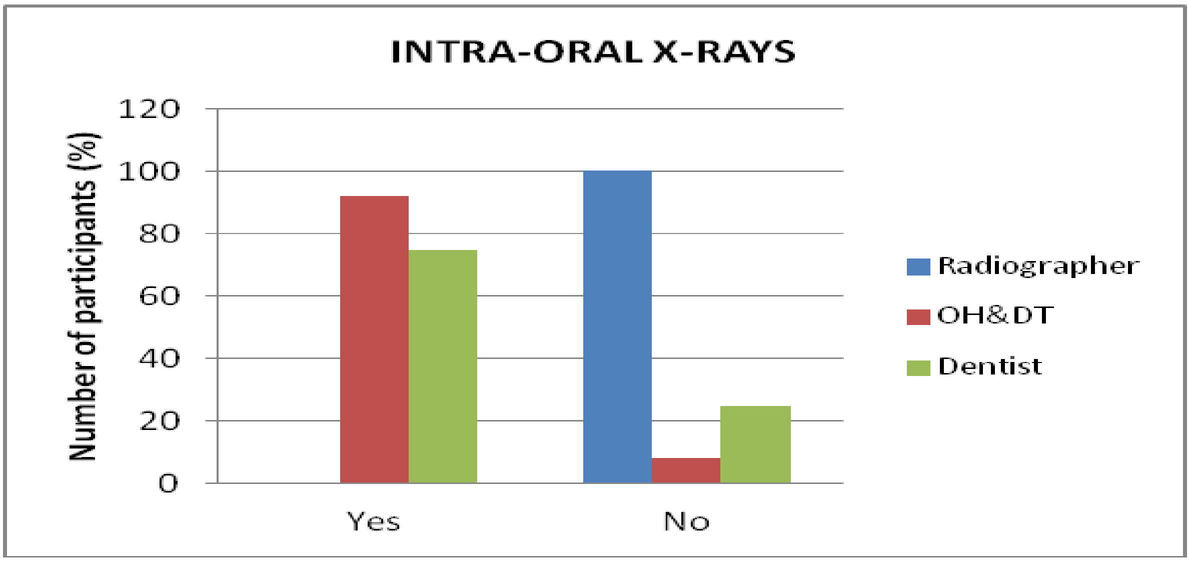


Figure 4.3: Distribution of responses on whether intra-oral X-rays are done in their institution

One would have expected a hundred percent indication of intra-oral x-rays done in a dental setting, contrary to the percentages reflected in Figure 4.3 (83%). This is a crucial, basic diagnostic tool that District hospitals should have as per the National District Norms and Standards of the National Department of Health. It is difficult to deduce from the above whether the few Dentists (25%) responding negatively was due to not understanding what intra-oral X-rays are or they just simply do not have resources.

Figure 4.4 indicates the distribution of responses to the question on the notion of a safe dose of radiation that one can be subjected to in a day.

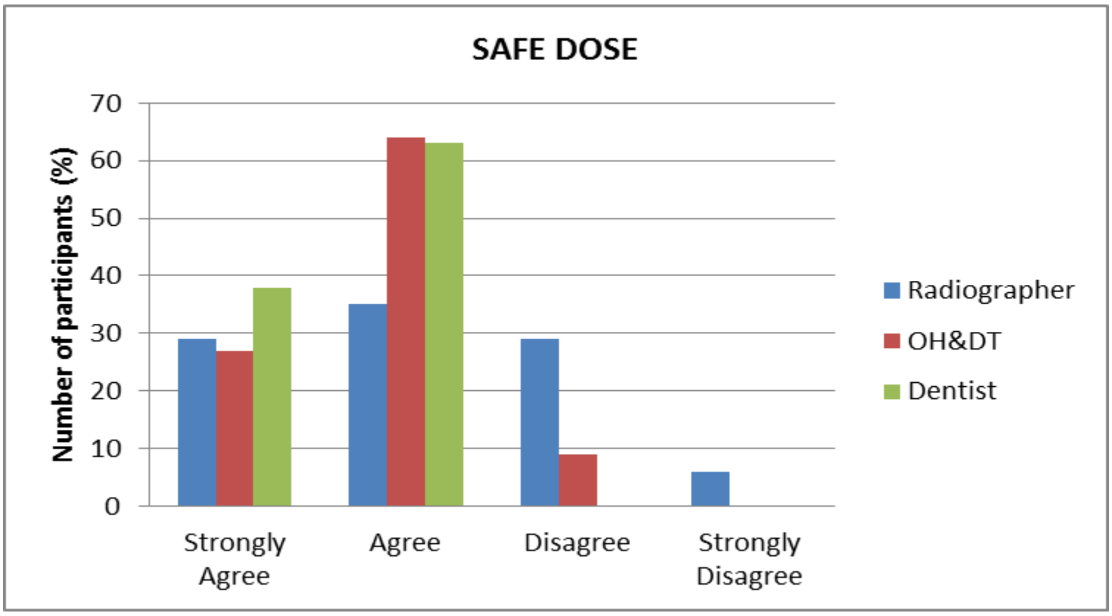


Figure 4.4: Distribution of responses on whether there is a safe dose of x-ray radiation in a day

Altogether, almost sixty five percent of all radiographers seemed to agree (29% agree and 35% strongly agree) that there is a safe dose of radiation from x-rays that one can take in a day. Similarly 91% of OH & DT (27% agree and 64% strongly agree) and 100% (63% agree and 37% strongly agree) Dentists share the same view. However, scientific research shows that even though there is little publications on long term exposure to radiation, one can never definitely say there is any dose that is safe. The understanding is that any amount of radiation may pose some risk of cancer or genetic defects (Nias, 1999; Walden & Farzeneh, 1990) .There are, however, guidelines on occupational exposure doses, the dose of which is 20mSv per annum (Radiation Directorate: National Department of Health, October 2009).

The respondents were asked whether a pregnant radiographer can continue performing her X-ray duties. The participants' responses are shown in Figure 4.5 below.

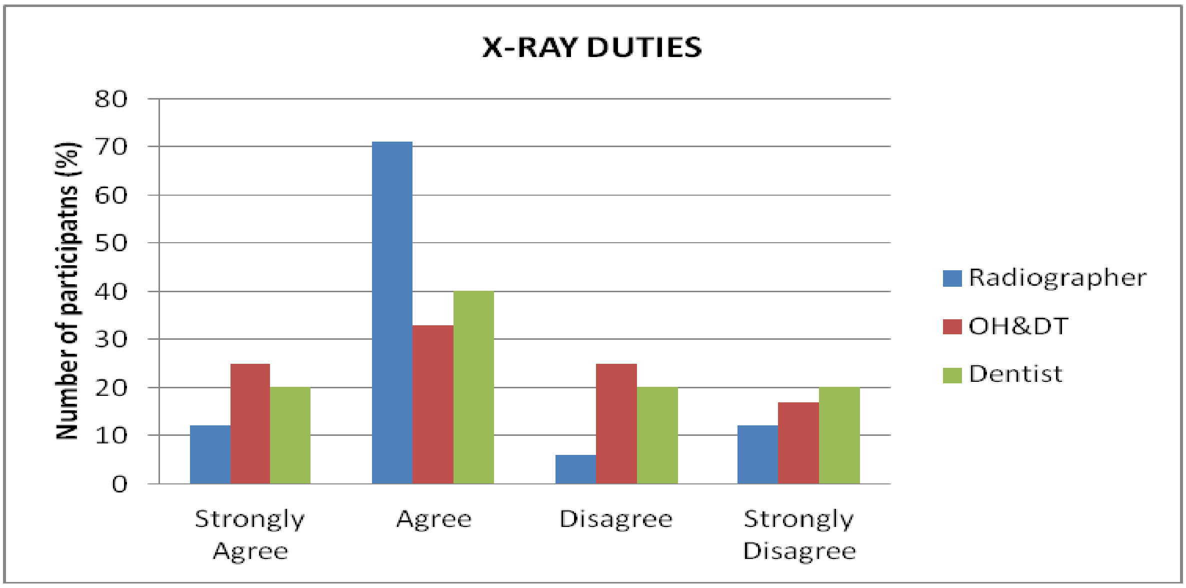


Figure 4.5 Distribution of responses on the performance of X-ray duties by a pregnant radiographer

A small percentage of radiographers, eighteen percent (6% disagree and 12% strongly disagree) did not agree that a pregnant radiographer can continue to perform her X-ray duties, with some dental professionals (45% disagree and 37% strongly disagree) also disagreeing. According to the Code of Practice for Radiation Workers (National Department of Health, 2010), a pregnant radiographer can continue working but the maximum equivalent dose limit of 2msV to the abdomen should not be exceeded. They should be monitored and issued with a direct reading pocket alarm dosimeter. Women of child bearing age are singled out as those who should be well-versed with the use of ionizing radiation (Code of Practice for Medical X-ray Equipment: National Department of Health, 2010).

4.4 COMPLIANCE TO RADIATION SAFETY PROTOCOLS

This third section (Questions 4 & 5) deals with compliance to measures put in place to reduce radiation exposure.

4.4.1 Compliance to Wearing Protective Clothing

The respondents were asked about the extent to which they comply in respect of wearing a dosimeter. The responses were recorded using a four point scale ranging from always to never as shown in Figure 4.6 below.

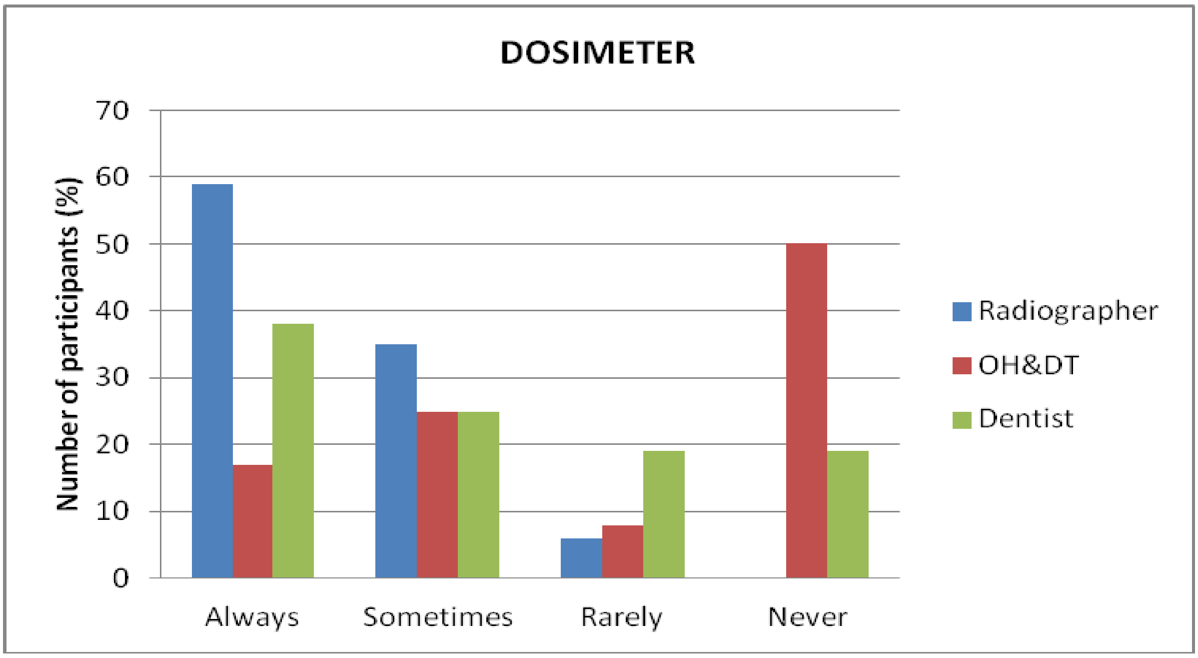


Figure 4.6 Distribution of responses on compliance with regard to wearing a dosimeter

It is apparent from the Figure that the participants were oblivious to the importance of complying with the wearing of a dosimeter, with some indicating sometimes (35% radiographers, 25% OH&DT and Dentists respectively), rarely (6% radiographers, 8% OH&DT and 19% Dentists) or never wearing a dosimeter (50% OH&DT and 19% Dentists). Only 59% of radiographers, 17% of Oral Hygienists & Dental Therapists and 38% of dentists always wore their dosimeters. A film badge is used for monitoring cumulative exposure to ionizing radiation that occupational workers absorb. The fact that only 59% of radiographers wore dosimeters is worrisome. These are professionals whose daily job is to take X-rays but yet do not see the need to protect themselves from the ionizing radiation. Readings from the badges are analyzed on monthly basis by a service provider (South African Bureau of Standards, 2001). Reports are sent to institutions if abnormalities are detected. For those who do not wear dosimeters, it becomes a wasteful expenditure and a health risk. However, there are no clear measures in place for monitoring compliance with regard to this.

Figure 4.6 also shows that 38% of dentists and 17% of OH&DT seem to comply with the wearing of a dosimeter. Non-compliance could also be due to how they were trained that they only need to wear a dosimeter under certain circumstances (Guidelines for Dental Radiography, National Department of Health, 2009). For example, dental professionals operating X-ray machines are required to wear a personal dosimeter when the position of the operator during exposures is less than 2 metres. This can only be practical if there are infrastructural compliance and monitoring. The license holder in an institution is responsible to determine whether a dosimeter must be issued to those performing dental examinations or not. The license holder must keep a register of the monthly reports furnished by the South African Bureau of Standards for such radiation workers (Radiation Directorate: National Department of Health, 2009). According to numerous studies, scientists do concur with the fact that complying with radiation safety standards does minimize drastically the occupational exposure to radiation for health care professionals (New Jersey Dental School, 2005; Hutchinson et al., 1999).

4.4.2 Compliance to Radiation Protection on Patients

Figure 4.7 below gives information on compliance with protection of patients from radiation by participants

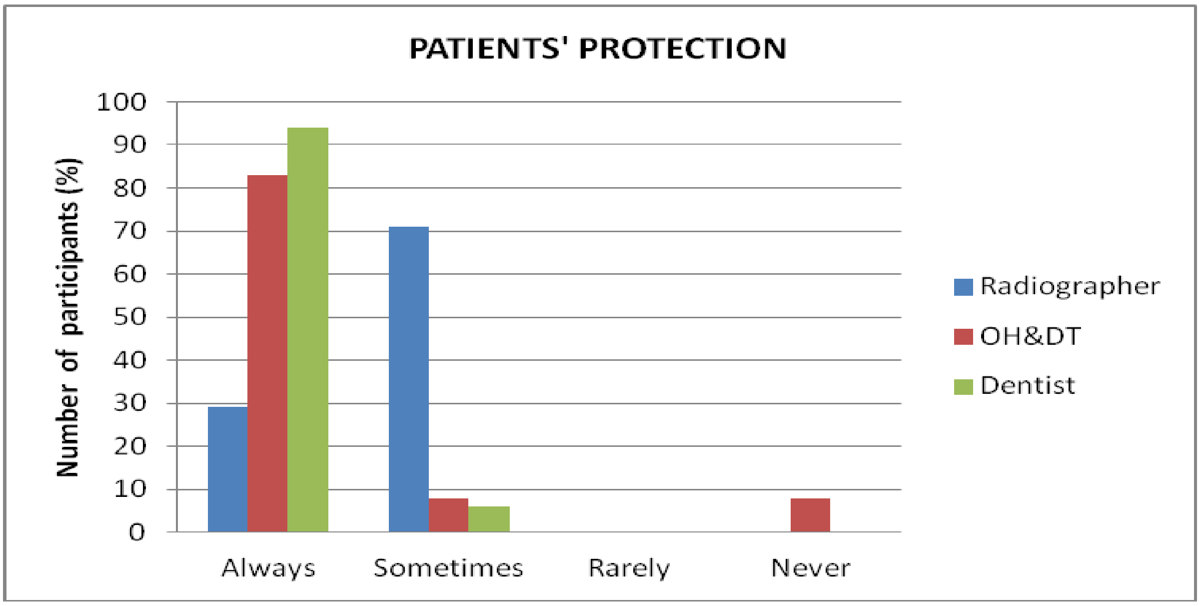


Figure 4.7 Distribution of responses on compliance with patients' protection

It is clear from Figure 4.7 that 29% of radiographers agree to always protecting patients before radiological examinations. Health-care professionals (radiographers and dental professionals) do not understand the ill-effects of radiation exposure on the patients. For radiographers whose daily routine work involves radiation, but fail to protect their patients, is worrisome. This could be linked to the bigger picture of lack of knowledge regarding the ill-effects of radiation exposure or just negligence (Codes of Practice, Radiation Directorate, 2009). This was quite peculiar as dental professionals (Dentists, OH & DT), indicated that they protect the patients as reflected in Figure 4.7 above (93% and 83%, respectively).

This practice of not always protecting patients before radiological procedures are done, takes advantage of patients' lack of knowledge on radiation effects. It is a great disservice to the community. This conforms well to a study by Shiralkar et al. (2003) who found that most doctors do not know the dose levels of radiation that their patients get exposed to during radiological investigations. They routinely request X-rays without weighing the necessity, thereby subjecting patients to more radiation risks. However, the Radiation Directorate is very clear on the importance of wearing protective clothing by both the operator and patients (Guidelines on users of X-ray equipment, National Department of Health, 2010). Before anyone is appointed as a radiation worker, a medical examination must be done by the employer. The medical examination follows the general occupational medical practice for determining fitness for work. Unfortunately, this practice is not always in place. Annual medical examinations are no longer required by the National Department of Health-Radiation Directorate, but it still remains the prerogative of the license holder to do them (Radiation Directorate: Department of Health, 1999). It is important for health-care professionals to realize that with modern technology, patients are becoming knowledgeable on some of these issues and are gradually becoming aware of what is expected when undergoing radiological procedures. It is the responsibility of the health-care professionals to provide first hand information to patients undergoing all radiological procedures (Codes of Practice, Radiation Directorate, 2009).

In a study of Michigan dentists by Nakfoor & Brooks (1992), only 49% of the 398 participants used cervical collars contrary to the use of leaded aprons being universal and having proved to reduce the radiation dose exposure.

4.4.3 Protection of patients against radiation exposure

Figure 4.8 below indicates the participants' response to X-ray records kept and whether procedures were repeated.

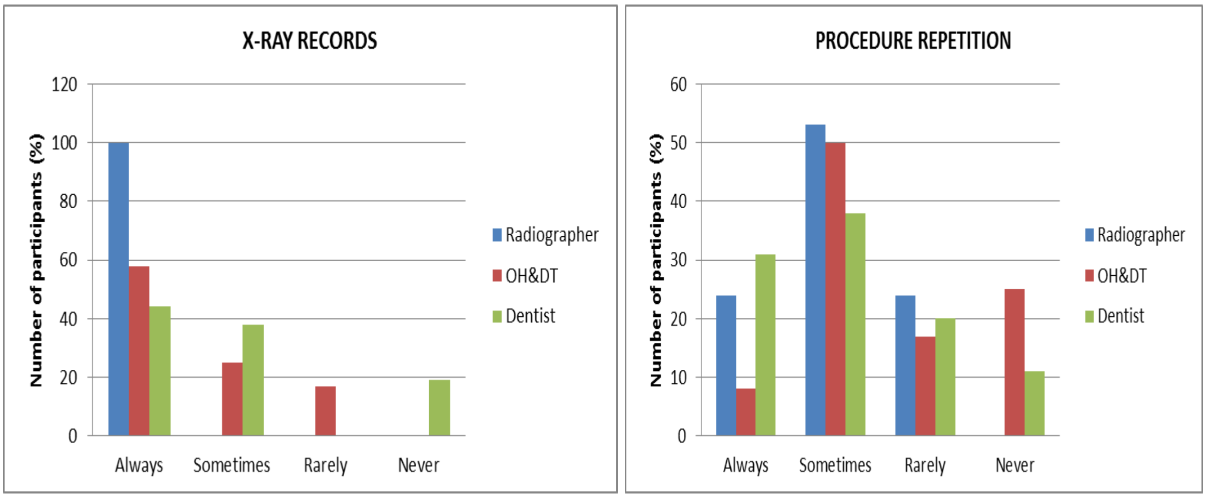


Figure 4.8 (a) Distribution of responses on X-ray records kept **(b)** Repetition of procedures

Figure 4.8 depicts the distribution of participants' responses on keeping patients' x-ray records and how often procedures were repeated. Compliance with radiation safety protocols includes the filing or keeping of X-ray records. Thirty eight percent of Dentists indicated to only sometimes keeping patients' records and 19% never keep the patients' records. This could lead to patients being subjected to further radiation. Requirements for dental radiography stipulate that a record/register of all patients undergoing X-ray examinations must be stored for a period of at least 5 years (Guidelines: Dental Radiography, National Department of Health, 2009). Similarly, the repetition of X-rays is discouraged. This is in line with the ALARA principle which expects health-care professionals to minimize radiation exposure to patients. Radiographers seem to be doing well in ensuring patients records are kept, with 100% of all participants indicating that they comply with the requirement.

Figure 4.8 (b) indicates the frequency of repetition of X-ray procedures. About 59% of all participants (24% radiographers, 17% OH&DT and 19% Dentists) rarely repeat procedures whereas 63% of all participants (24% radiographers, 8% OH&DT and 31% Dentists) always repeat procedures. Repetition could also result from poor record keeping, unnecessary requisition of X-rays and not paying attention and considerable care to ill-effects of chronic exposure to radiation.

The above echoes the findings from the study by Arslanoglu et al., (2007), assessing doctors' knowledge about patients' ionizing radiation exposures during common radiological examinations Ninety three percent of the 177 doctors who participated underestimated the actual radiation dose of various radiological examinations. Doctors seemed to expose patients to radiation without considering the consequences thereof.

4.4.4 Compliance to radiation safety protocols

Figure 4.9 depicts the responses on the exposure risks to radiation the health-care professionals feel they are subjected to.

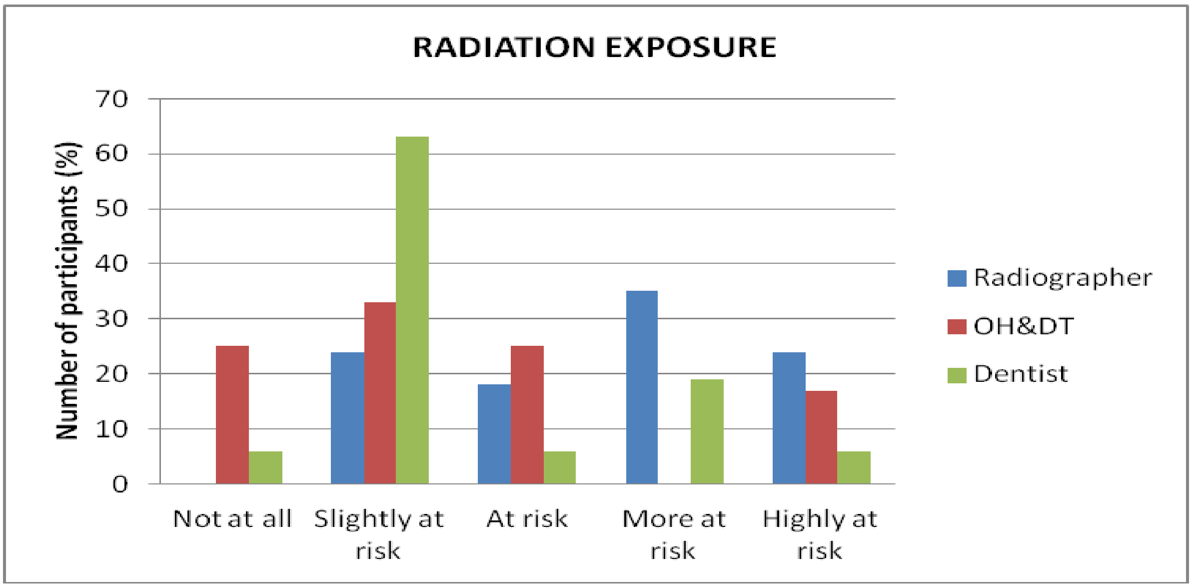


Figure 4.9 Participants' responses on the risk to radiation exposure by health-care professionals

Figure 4.9 shows the level of radiation risks health-care professionals feel exposed to, as compared to other health-care workers in their institutions. Radiographers felt exposed to radiation (more at risk, 35% and highly at risk 24%) than other health-care professionals with the majority of dentists (63%) feeling slightly at risk. The responses indicated some degree of concern by respondents which could be viewed as a level of ignorance in terms of the responsibility of the employer in complying with the Occupational Health and Safety Act No. 85 of 1993. This piece of legislation ensures that the employer provides a safe and conducive working environment that is free of hazards.

Most radiographers attributed to their feeling more and highly at risk to radiation exposure than other health-care professionals to their working with radiation on a daily basis. Some of the radiographers mentioned the use of portable X-ray units as the ones that put them more at risk. No protective shields were provided. It is, however, not clear as to who should provide the protective shields or whether it is just a tendency for Radiographers not to carry lead aprons when taking X-rays in the wards. This is how one participant tried to emphasize how portable X-ray units put them at risk:

> *"Portable mobile in the wards, due to shortage of lead aprons" Radiographer 1*

> *"Because we do mobile X-rays, theatre and screening procedures that produce too much radiation that affects us at all time" Radiographer 2*

> *"Working with radiation everyday puts radiographers at radiation exposure risk especially when doing mobile X-rays" Radiographer 3*

Radiographers generally felt they are highly at risk to radiation exposure by virtue of working with radiation on daily basis.

Figure 4.9 shows that a majority of dentists (63%) felt slightly at risk, but those who felt more (19%) or highly at risk (6%) were not happy with the failure of their institutions in providing them with protective wear. The same sentiments were shared by other dental professionals and some of their comments are quoted below:

> *"I do not have a dosimeter to regulate radiation exposure, gosh what negligence" Oral Hygienist*

> *"Because I do not have a dosimeter in my section" Dental Therapist*

Issues relating to infrastructural problems also came up as contributing factors towards the risk of exposure to radiation:

> *"Our X-ray machines have not been checked for some time, we are not sure as to whether X-rays are leaking or not" Oral Hygienist*

4.5 COMMUNITY'S KNOWLEDGE OF RADIATION EXPOSURE RISKS

The focus in this section was to establish whether health-care professionals were aware that compliance with radiation safety protocols was part of their responsibilities. This implies that they had to let their patients know about the risks they would be subjected to every time they undergo a radiological procedure. Figure 4.10 indicates the participants' responses.

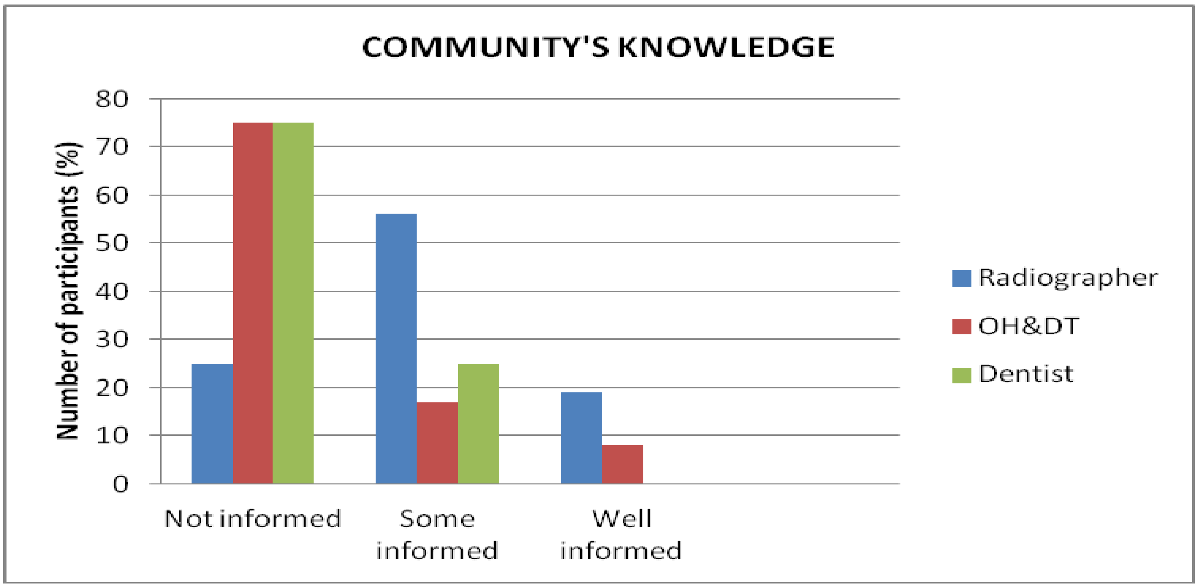


Figure 4.10 Distribution of responses on the community's knowledge to radiation exposure risks

Figure 4.10 above shows that 25% of radiographers and 75% dental professionals held a view that the community was not informed at all about radiation exposure risks. They gave reasons ranging from illiteracy in the community to lack of awareness programmes by health-care professionals. Ignorance also contributed to this finding, as there had always been information displayed in X-ray rooms, indicating caution and how pregnant patients should be managed. Health-care professionals have a responsibility to explain procedures and possible ill-effects to patients, and benefits thereof. Consent should be sought from the patients before they undergo any radiological procedure. However, health-care professionals also felt it is upon the patients to be curious about X-ray procedures done on them, and learn to keep their X-rays when referred further to avoid more exposure to radiation.

The health-care professionals' sentiments on the knowledge of radiation exposure risks were as presented below:

> *Not informed, "Because they ask why we put lead apron every time we take X-rays" Dental Therapist*
>
> *Some informed, "Especially pregnant patients are told about radiation exposure risks" Oral Hygienist*
>
> *Not informed, "The majority of patients that come to our sections know nothing about X-rays or radiation" Dentist 1*
>
> *Not informed, "I don't think the communities are informed about radiation exposure risks because of their level of education" Dentist 2*
>
> *Some informed, "Some people will request an X-ray from a doctor for injuries that do not warrant an X-ray, that tells me some people might not be aware of the dangers" Radiographer 1*
>
> *Well informed, "The moment you enter the X-ray Department there are boards/pictures displayed on the wall about X-rays, females of childbearing age are always asked by a radiographer whether they are pregnant or not" Radiographer 2*

4.6 RADIATION SAFETY PROTOCOLS AND X-RAY ROOM DESIGNS AT INSTITUTIONAL LEVEL

Participants were asked about radiation safety protocols practiced in their institutions, which are in line with the Radiation Safety Protocols from the Radiation Directorate: National Department of Health.

Table 4.2 below shows the various safety protocols practiced by health-care professionals at various institutions.

Table 4.2: Distribution of responses on various safety protocols and X-ray room designs indicated by respondents

Safety Protocol	Radiographers	OH&DT		Dentists		Total	
	N (%)	N (%)		N (%)		N (%)	
Protective Wear							
Dosimeter	1 (8)	4 (57)		6(46)		11 (33)	
Lead Apron	12 (92)	3 (43)		7(54)		22 (67)	
ALARA Principles							
Low exposure	6(60)	1 (50)		2(67)		9 (60)	
Reduce X-rays taken	4 (40)	1 (50)		1(33)		6 (40)	
Infrastructure							
Lead lined walls	1 (100)	2 (50)		1(33)		4 (50)	
Exposure switch outside	0 (0)	2 (50)		2(68)		4 (50)	
Equipment							
Use of grid	1 (50)	1 (100)		2(100		4 (80)	
Collimation	1 (50)	0 (0)		0(0)		1 (20)	
Protection in pregnancy							
Signs put up and female patients of reproductive age asked if they are pregnant	3 (100)	----	----	--	----	3 (100)	100%
Quality Assurance Tests							
Done regularly	1 (33)	------	-----	---	----	1 (33)	
Reports available	2 (68)	----	----	---	-----	2 (68)	

The protocols displayed in Table 4.2 above should be familiar to the participants and be practiced on daily basis in their workplace. It was worrisome that their responses indicated some degree of ignorance or failure to understand the consequences of not correctly implementing protocols. Such actions have a negative impact on both the health-care professionals and the community at large. It also brings into question the monitoring and evaluation methods used by the employer in ensuring safety by the user and the patients.

A response by one Dental Therapist on the safety protocols was as follows:

"I don't know" Dental Therapist 1

Participants indicated various safety protocols practiced in their institutions and the gaps thereof. Out of 46% of Dentists who indicated that wearing dosimeters was an important safety protocol, one reported that they were not provided with dosimeters by the authorities as per requirements. This was consistent with the study by Nakfoor and Brooks of the Michigan School of Dentistry (1992), where of the 398 dentists surveyed, 73% did not comply with radiographic safety recommendations.

Some dentists (67%) complained about lack of monitoring and Quality Assurance tests that are not being done. Only 33% of radiographers indicated compliance in Quality Assurance Tests. One would have expected all respondents to have mentioned just half of the above safety protocols. The participants' level of knowledge is inadequate. Similarly, in a Michigan study of compliance with radiographic safety recommendations, it was found that the majority (73%) of Dentists in private practice surveyed did not comply with the recommendations on the film speed, collimation and the use of leaded cervical collar (Nafkoor & Brooks, 1992)

Some concerns about leakages of equipment were raised by respondents in their comments, but more as a perception of professionals relating their unsafe working environment, than based on facts from the Quality Assurance test. Only one respondent, a radiographer indicated that Quality Assurance Tests are not done regularly on their machines as per requirement by the National Radiation Directorate. A hazardous environment in the workplace is clearly a contravention of the Hazardous Substance Act 15 of 1973. Indications relating to some structural flaws were also mentioned that participants felt put them at risk, (e.g. walls not being lead lined -50%, X-ray switches which are located within the X-ray rooms -50%), and putting the responsibility of estimating distance from the source on them which is practically difficult to do. There are very clear guidelines relating to the design of X-Ray rooms. Eighty five percent of all participants felt their X-ray rooms do not comply with the design guidelines, with 100% of Radiographers sharing the view.

However, knowledge of radiation ill-effects and compliance with safety protocols, remain a concern as reflected in Table 4.2. This is in conformity with data from a study on Portuguese students' knowledge of radiation physics that although students, like the general population, understand the importance of radiation, it is not clear whether they understand its meaning (Rego & Peralta, 2006). Another study including Doctors and intern Doctors from 3 universities, investigating their level of knowledge about their patients' radiation exposure doses during radiological examination, showed that they did not know that ultrasound and magnetic resonance imaging do not utilize ionizing radiation (Arslanoglu et al., 2007).

4.7 CONCLUSION

This study demonstrated that the level of knowledge of the participants on radiation and its ill-effects was inadequate and actually that they underestimated the long term impact. Even though a considerable number of participants (69%) agreed that any amount of radiation exposure is a health hazard, their non-compliance with radiation safety protocols in their daily radiological practice is a concern. Figure 4.10 also indicated an interesting observation from this group, whereby 25% of radiographers and 75% of dental professionals acknowledge that the community is not well informed about radiation. They however further continue in the open ended questions to dissociate themselves from the responsibility of educating patients about radiation exposure risks. Explaining implications of radiation should be regarded as a mandatory task and responsibility to be carried out by all health-care professionals, compounded with the understanding of the physics, chemistry and biology of radiation in order to effectively communicate about it.

CHAPTER 5

CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This Chapter outlines the conclusions resulting from this study and the implications thereof. It also seeks to highlight some short-comings and strengths of the study. Furthermore, recommendations in terms of closing certain identified gaps will be presented.

5.2 CONCLUSIONS FROM THE STUDY

This study demonstrated that there was generally a lack of in-depth understanding of what ionizing radiation is, in particular, the ill-effects of chronic exposure to low levels. Respondents could not differentiate between ionizing and non-ionizing radiation, with 63% of radiographers failing to recognize UV Rays as a form of ionizing radiation.

It was worrisome that only 11% of all respondents indicated that they never repeated procedures because repeating procedures subject patients to recurrent exposures. In radiological practice, in keeping with the ALARA principle, minimum exposure to both the patient and the health-care professional is what is advocated. This further brings the issue of compliance with safety protocols to the author's attention. On the last part of the questionnaire that requested participants to indicate the safety protocols in their institutions, most of the respondents failed to mention as many as two. Only 11 respondents (1 radiographer & 10 Dental professionals) mentioned the wearing of a dosimeter, the protective equipment that is critical to monitor the dose of radiation health-care professionals could absorb. It was rather puzzling to realize how health –care professionals believed with confidence about the existence of a safe dose of radiation. Scientifically, a safe dose of radiation levels does not exist.

Only forty six percent of dentists indicated the wearing of a dosimeter as an important safety protocol, with 59% of radiographers also failing to comply. This, a disturbing finding for such an integral safety tool for health-care professionals.

It was also noted that respondents were not worried much about the lack of information in the community regarding radiation exposure risks. In addition, they felt it was not their responsibility to educate communities. This is contrary to the Code of Practice for Users of X-ray equipment as per the

National Radiation Control. It is the responsibility of the health-care professional to give first-hand information to the patients undergoing radiological procedures. More public awareness and media attention on radiation, either due to disasters of the world or continuous research has made radiation use to be under scrutiny. With escalating medical litigations in our country, radiation exposure is slowly becoming of interest not just as an occupational hazard but to patients and communities affected thereof.

The biggest challenge is the issue of compliance by institutions with clear legislative mandates, lack of monitoring and evaluation programmes by the employer. It was also worrisome that health–care professionals failed to list various safety protocols. It was not apparent whether guidelines are in place or not. Only 1 radiographer was able to mention a dosimeter as an important safety feature.

The lack of knowledge regarding radiation ill-effects, compliance with safety protocols seem to be in line with those reported previous studies. The need for more on the job training or workshops as indicated in the study by Ryan et.al is an example that can be looked into. It should not be assumed that health-care professionals will know better about radiation dose. This study agrees with the studies done by Dryer et al.,(1981), Hutchinson et al.,(1999) and Rego & Peralta (2006).

In the South African context, the health-care professionals in this study have both done undergraduate courses in Radiography and Radiology but the gaps have been identified in the workplace. Radiation has become an important public health topic in our country too (Mapiloko, 2008:8), and this should be a further indicator that health institutions should give it attention.

This study therefore concludes that there is lack of knowledge among health-care professionals, failure to comply with safety protocols and reluctance in engaging with patients.

5.3 LIMITATIONS OF THE STUDY

The significant limitation of the study was being unable to observe the subjects during various radiological procedures, starting with the interaction with the patients, where consent is sought and radiation risks explained. It is acknowledged that the questionnaire might not have been sufficient to address the key questions in depth because of the inability to probe further, but the open-ended portion complemented this shortfall. Consideration was also taken to the fact that the study will be done during official working hours, and therefore would not want to cause disruptions or take participants off work for a long time. The study lacks triangulation; i.e., neither interviews nor observations were done.

Despite the limitations listed above the open-ended portion of the questionnaire complemented this shortfall. A cohort study could also assist in determining how much individual dose is absorbed over a certain period of exposure to low levels radiation

5.4 IMPLICATIONS OF THE STUDY IN LIMPOPO PROVINCE

Two institutions in the Waterberg District had their X-ray Departments shut down due to non-compliance. This study will have a positive impact towards the improvement of radiation safety standards.

5.5 RECOMMENDATIONS

The curricula at mainstream universities and universities of technology for both dental professionals and radiographers should include issues around radiation exposure effects. The legislative framework, the guidelines and protocols should be clearly indicated by the Radiation Control Directorate in the National Department of Health. Further studies of low-dose level ionizing radiation should be pursued.

It is therefore recommended that both the employer and the health-care professionals take it upon themselves to jointly reduce the risk of the ill-effects of the chronic exposure to low dose radiation in the long term.

Particular attention should be paid to the following:

- Patient education about radiation and its effects should be part of the responsibilities of health-care professionals
- The employer must ensure that all the necessary protective clothing are provided
- The employer must ensure that protocols are followed and adhered to without failure
- Infrastructural problems should be dealt with so that facilities comply with the guidelines on design of X-Ray Rooms by Radiation Directorate, National Department of Health
- Codes of practice should be in place that outline guidelines on:
  Dental Radiography
  Medical Examination for Radiation Workers

Radiation Monitoring Requirements and Radiation Occurrences

Protective Clothing

- The employer should monitor the services of SABS (currently the employer enlists the services of SABS to measure radiation exposure doses of health-care professionals, but it is not clear how these are monitored by the employer). The employer needs to take interest in reports from this body.
- Health-care professionals should be encouraged to read the reports sent from their dosimeter readings
- Refresher courses, continuous educational programmes to occupationally exposed health-care professionals should be reinforced and should be extended to patients and communities at large
- Proper procurement procedures relating to electronic products should be complied with.
- The final responsibility of ensuring compliance with radiation control legislation should lie with the employer in enforcing proper monitoring mechanisms.

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ANNEXURES

Annexure 1: Application letter to conduct Research in the Waterberg District hospitals

TO: THE CHAIRPERSON
RESEARCH AND ETHICS COMMITTEE
DEPARTMENT OF HEALTH AND SOCIAL DEVELOPMENT
LIMPOPO PROVINCE

Dear Sir/Madam

I hereby apply for permission to conduct a research, which is part of the requirements for my Master in Public Health Degree at the School of Public Health, University of Limpopo. This study aims to determine the compliance to radiation safety protocols by healthcare professionals, in particular, radiographers and Dental professionals. Please note that this proposal was cleared with the Research and Ethics Committee of the University.

The Department will receive the results which will assist the Department in evaluating radiation safety programmes in health institutions.

Yours truly,

R.M. Modiba

Annexure 2: Questionnaire covering letter

MOKOPANE HOSPITAL
PRIVATE BAG X2466
MOKOPANE
0600

Dear Respondent

I am currently enrolled for a Master of Public Health with the University of Limpopo, Turfloop Campus. This research is for the fulfillment of my degree.

The attached questionnaire has 35 questions and may take 15 minutes of your time to complete it. The questionnaire consists of straight forward questions, some of the questions will require you to mark with an “X” on the blank spaces provided and some will require some detailed information. Kindly give as much information as possible.

The information provided will help in identifying reasons for either compliance or non-compliance to radiation safety protocols in Waterberg hospitals and even suggest some possible solutions.

I wish to inform you that the information you provide will be treated with the utmost confidentiality. You are welcome to withdraw your participation at any stage of this study.

The completed questionnaire will be collected from your institution.

Thank you for your interest in participating in this research project.

Sincerely,

R.M. Modiba
Tel: 015-4834078
Cell: 0727749291

Annexure 3: Data collection instrument

Answer the following with an X in the appropriate box: QUESTIONNAIRE

(Please mark with an "X" on one of the options provided).

Personal Information

Gender

Male	1	Female	2

Age …………………………..years

Level of Education

Grade 12 + Diploma	Degree	Post-graduate	Other(Specify)
1	2	3	4

Designation

Darkroom Operator	Radiographer	Oral Hygienist	Dental Therapist	Dentist
1	2	3	4	5

Years of service

Answer the following with an X in the appropriate box:

		YES	NO
2.1	Type of X-rays done in your setting are intra-oral	1	2
2.2	Type of X-rays done in your setting are extra-oral	1	2
2.3	X-ray equipments used in your setting utilize ionizing radiation	1	2
2.4	X-ray equipment used in your setting utilize non-ionizing radiation	1	2
2.5	Radiation sources may be found in health care facilities	1	2
2.6	X-rays are a form of ionizing radiation	1	2
2.7	X-rays are a form of non-ionizing radiation	1	2
2.8	UV rays are a form of ionizing radiation	1	2
2.9	UV rays are a form of non-ionizing radiation	1	2

Answer the following with an X, using the following key:

SA = Strongly agree; A = Agree; D = Disagree: SD = Strongly Disagree

		SA	A	D	SD
3.1	Any amount of radiation exposure is a health hazard	1	2	3	4
3.2	We are exposed to radiation from natural sources all the time	1	2	3	4
3.3	All types of radiation produce the same effects in the human body	1	2	3	4
3.4	There is a safe dose of X-ray radiation in a day	1	2	3	4
3.5	Medical X-rays are a major source of man made radiation exposure	1	2	3	4
3.6	X-rays can be used for both diagnostic and therapeutic purposes	1	2	3	4
3.7	Radiation has both beneficial and detrimental effects in the human body	1	2	3	4
3.8	There are potential health hazards associated with the radiological equipments used in our setting	1	2	3	4
3.9	There are potential health hazards associated with the procedures done in our setting	1	2	3	4
3.10	Radiation becomes a risk depending on the frequency of exposure	1	2	3	4
3.11	Exposure to radiation can cause cancer	1	2	3	4
3.12	It is absolutely safe to undergo a mammography	1	2	3	4
3.13	A pregnant radiographer can continue to perform her X-ray duties	1	2	3	4
3.14	A patient undergoing a CT Chest is subjected to more effective radiation dose than one taking tooth X-ray	1	2	3	4

Answer the following using the scale provided:

A=Always, S=Sometimes, R=Rarely, N=Never

		A	S	R	N
4.1	I put on my dosimeter when in my working area	1	2	3	4
4.2	I keep monthly records of dosimeter readings as supplied by SABS	1	2	3	4
4.3	Patients are covered with lead apron / wear collar before procedures are done	1	2	3	4
4.4	Pregnant healthcare workers working with radiation machines are more at risk than others	1	2	3	4
4.5	I am more exposed to radiation than other health professionals	1	2	3	4
4.6	Annual inspection reports of our X-ray Department from Radiation Control Board, National Department of Health are received	1	2	3	4
4.7	I read reports received from the Radiation Control Board, National Department of Health	1	2	3	4
4.8	Patients' X-rays are properly kept/filed	1	2	3	4
4.9	I repeat procedures because the X-ray is not clear	1	2	3	4

Answer the following briefly**:**

Choose and explain your answer

5.1 Do you feel you are more at risk to radiation exposure than other health professionals?

Not at all	Slightly at risk	At risk	More at risk	Highly at risk
1	2	3	4	5

Please explain your answer

………

………

………

……

Choose and explain your answer

5.2 Are the surrounding communities informed about radiation exposure risks?

Not informed	Some informed	Well informed
1	2	3

Please explain your answer

………

………

………

………

5.3 What are the radiation safety protocols in your institution?

………

………

Annexure 4: Question 5-coding scheme for statistical analysis

5.1 a) Risk

Not at all	Slightly at risk	At risk	More at risk	Highly at risk
1	2	3	4	5

Explanation of 5.1(a) above:

KEY WORDS	SUB-CATEGORY
1: Radiation	0: Does not use radiation daily/rarely 1: Use radiation daily/Frequently 2: Low radiation dose
2: X-Rays	0: Does not take X-rays often/rarely 1: Takes X-Rays often/always/daily 2: Repetition of X-Rays
3: Protective wear	0: Not available 1: Available
4. Infrastructure	0: Does not comply 1: Complies with radiation safety protocols

5.2 a) Information

Not informed	Some informed	Well informed
1	2	3

Explanation of 5.2(a) above:

KEY WORDS	SUB-CATEGORY
1: No Information/knowledge	0: Effect of radiation to body not known/unknown 1: No health awareness programmes about radiation 2: Questions asked about radiation asked(e.g.why they wear protection)
2: Information	1: information about radiation displayed for all to read 2: information about radiation given to patients prior to procedures being done:
3: Education	0: Low

5.3

KEY WORDS	SUB-CATEGORY
1: Protective wear	1: Dosimeter 2: Lead apron
2: ALARA principles	0: Low exposure 1: Reduce/avoid repeating X-Rays
3: Infrastructural compliance	1: Lead lined walls 2: Exposure switch outside X-ray room
4: Equipment used	1: The use of grid 2: No leakage of equipment used 3: Collimation
5: Protection of pregnant women	1: info given to pregnant women
6: Quality Assurance	1: Done regularly 2: Reports available

Annexure 5: Clearance Certificate from MEDUNSA Research & Ethics Committee

UNIVERSITY OF LIMPOPO
Medunsa Campus

UNIVERSITY OF LIMPOPO

MEDUNSA RESEARCH & ETHICS COMMITTEE

CLEARANCE CERTIFICATE

P O Medunsa
Medunsa
0204
SOUTH AFRICA

Tel: 012 - 521 4000
Fax: 012 - 560 0086

MEETING: **01/2010**

PROJECT NUMBER: **MREC/H/12/2010: PG**

PROJECT :

Title:	Compliance to radiation safety standards by radiographers and dental professionals in Waterberg district hospitals: Limpopo Province
Researcher:	Dr R Modiba
Supervisor:	Prof TT Netshisaulu (Physics)
Co-supervisor:	Dr MBL Mpolokeng (Public Health)
Hospital Superintendent:	Ms M Mahlo (Limpopo Department of Health)
Department:	School of Public Health
School:	Health Care Sciences (Turfloop Campus)
Degree:	Master in Public Health

DECISION OF THE COMMITTEE:

MREC approved the project.

DATE: 04 February 2010

RESEARCH & PARTNERSHIP
2010 -02- 0 4
MEDUNSA CAMPUS

PROF GA OGUNBANJO
CHAIRPERSON MREC

Note:
i) **Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee.**
ii) **The budget for the research will be considered separately from the protocol.**
PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

African Excellence - Global Leadership

Annexure 6: Permission to conduct study from the Department of Health, Limpopo

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF HEALTH AND SOCIAL DEVELOPMENT

Enquiries: Ramalivhana NJ/Malomane EL

Ref: 4/2/2

25 May, 2010
Dr Modiba R
School of Public Health
University of Limpopo
SOVENGA
South Africa

Dear Dr Modiba R

"Compliance to radiation safety standards by radiographers and dental professionals in Waterberg hospitals: Limpopo Province"

Permission is hereby granted to Dr Modiba R to conduct a study as mentioned above in Limpopo Province South Africa

- The Department of Health and Social Development will expect a copy of the completed research for its own resource centre after completion of the study.
- The researcher is expected to avoid disrupting services in the course of his study
- The research results must be used only for the purpose of the study
- The Researcher/s should be prepared to assist in interpretation and implementation of the recommendations where possible
- The Institution management where the study is being conducted should be made aware of this,
- A copy of the permission letter can be forwarded to Management of the Institutions concerned

HEAD OF DEPARTMENT
HEALTH AND SOCIAL DEVELOPMENT
LIMPOPO PROVINCE

Private Bag X9302 Polokwane
18 College Str., Polokwane 0700 • Tel: 015 293 6000 • Fax: 015 293 6211 • Website: http/www.limpopo.gov.za
The heartland of southern Africa - development is about people