THE ASSOCIATION OF DEMOGRAPHICS AND OCCUPATIONAL FACTORS WITH LATENT TUBERCULOSIS INFECTION IN RADIOLOGY STAFF AT PUBLIC SECTOR HOSPITALS IN THE ETHEKWINI HEALTH DISTRICT

A dissertation submitted in fulfilment of the requirements for the degree of Master's of Technology: Radiography in the Faculty of Health Sciences at the Durban University of Technology

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DECLARATION OF ORIGINALITY

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is entirely my own and not of any other persons, unless explicitly acknowledged (including citation of published and unpublished sources).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

Candidates name: Miss Shiroma Ackah

Candidates Signature: _____ Date: __/__/___

ETHICAL CLEARANCE

This is to certify that the studies contained in this dissertation have the approval of the Institutional Research Ethics Committee (IREC) of the Durban University of Technology (DUT) in Kwazulu-Natal.

The allocated Ethical clearance number is: IREC 047/12

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ABSTRACT

Introduction

Tuberculosis remains a leading cause of death, second to the Human Immunodeficiency Virus. The risk of latent tuberculosis infection and active tuberculosis disease is a known occupational hazard. In South Africa, a high tuberculosis burden country, the potential of *Mycobacterium tuberculosis* transmission to health care workers is high. This includes diagnostic radiographers and other radiology staff working in radiology departments.

Purpose of the Study

This study aimed to investigate the association of demographic and occupational factors with latent tuberculosis infection in radiology staff in public sector hospitals of the eThekwini Health District.

Methodology

This cross-sectional study was conducted from 26 February 2013 to 07 June 2013. Quantitative methods were used to test for associations of demographic and occupational factors with latent tuberculosis infection in participants. A sample size of 181 participants for an estimated population of 340 radiology staff was recommended at the proposal stage. The study consisted of two phases; the questionnaire survey (phase one) and the administration of a two-step tuberculin skin test (phase two).

Data was obtained with regard to demographics, occupational history, social behaviours, medical history; and family and home histories. Demographic and occupational associations with latent tuberculosis infection were made in relation to the size of the first tuberculin skin test induration. Frequency distributions were developed to describe data categories. Pearson's and Spearman rho' correlation coefficients were used to test for correlations

between the independent variables. The chi-square test was used to determine associations between the categorical independent variables and the dependent variable. Bivariate analyses were performed using these tests. The multivariate analysis was performed using logistic and linear regression on the dependent variable.

Results

A total of 182 questionnaires were returned from approximately 280 radiology staff. At the outset, all doctors working in the radiology department had to be excluded due to numerous failed attempts to enlist their participation. Fifty-three (29.12 percent) participants were excluded from phase one of the study and a further thirteen participants were excluded from phase two. The total sample was 116 participants. Of the 116 participants, 86.2 percent tested positive for latent tuberculosis infection at the first step of the two-step testing method used. One (0.86 percent) participant went on to convert at the second step, testing positive at this level.

Demographic associations with latent tuberculosis infection included age (older) as an associated factor. A significant demographic association with latent tuberculosis infection was the use of alcohol (*p*-value 0.033 on the multivariate analysis). Occupational associations with latent tuberculosis infection included longer durations of employment. The annual income (higher income earners) displayed significant associations with latent tuberculosis infection (*p*-value 0.048 on the multivariate analysis). It is necessary in this study to note that participants include support personnel (lower income earners) making up 37.8 percent of the study, diagnostic radiographers making up 48.3 percent; and radiography managers/assistant managers (highest income earners) making up 13.8 percent of the study.

Conclusion and recommendations

The risk of transmission of *Mycobacterium Tuberculosis* to health care workers is a known occupational hazard. This study has described the prevalence of

latent tuberculosis infection in radiology staff, at district and regional hospitals within the eThekwini Health District. With 23.62 percent of all participants already having active TB disease and 86.2 percent of the tested group displaying positive results for latent tuberculosis infection, using the tuberculin skin tests, the need for tuberculosis screening is essential. The findings of this study will be used as a health improvement mechanism for stakeholders, having identified potential gaps in medical screening in healthcare in Kwa-Zulu Natal. This study makes recommendations for the early detection of active tuberculosis infection and the monitoring of health care workers that are latently infected, thus assisting in reducing the rate of conversion of latent tuberculosis infection to active tuberculosis disease in radiology staff. This reduces long-term exorbitant costs related to health care associated infections, such as tuberculosis. It also reduces rates of transmission and cross infection to both co-workers and already immunocompromised patients, helping to curb the overall epidemic in South Africa.

DEDICATION

This dissertation is dedicated to my parents.

To my late father, Mr Palakdharie Ackah - no words can explain your contribution to my life and the impact you have made on both my career and academic path. Your strong will, hard work and faith in me has encouraged my determination to aim for success in everything that I do. My gratitude to you is immeasurable. I live with your memory, walking forward with you in my heart.

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- To the relevant Hospital managers and Radiography managers included in my study, thank you for allowing me time in your departments and providing me with the resources required to complete my study.

- To the participants, thank you all for sharing your personal information and participating in a study of this nature. The work that goes into an efficient diagnostic x-ray department is demanding and laborious and so my appreciation to you for taking time during long days and many shifts to participate will always be acknowledged. It is hoped that your contribution to this study will provide a template for the screening of LTBI in radiology staff and ultimately all health care workers.

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ABBREVIATIONS AND GLOSSARY OF TERMS

Bacille-Calmette-Guérin	**BCG**	The BCG vaccine is administered routinely at birth which immunises against tuberculosis (Dictionary of Medical Terms 2007: 39).
Centers for Disease Control and Prevention	**CDC**	A regulatory body facilitating the prevention and control of infectious diseases.
Department of Health	**DoH**	Referring to a provincial Department of Health.
Directly Observed Treatment Shortcourse	**DOTS**	A five component package, introduced in the 1990's that underpins the Stop TB Strategy (WHO 2012: iv).
District Hospital		Level one –only generalist staff are available. Basic diagnostic and therapeutic services are provided. An operating theatre is available, however no specialist anaesthetist. There would be no intensive care unit at a district facility (Cullinan 2006: 13).
Extensively Drug Resistant Tuberculosis	**XDR-TB**	Extensively drug-resistant TB, defined as MDR-TB plus resistance to a fluoroquinolone and at least one of three injectable second-line drugs (amikacin, kanamycin or capreomycin) (WHO 2012: iv).
High Burden Countries	**HBC**	The 22 countries, including South Africa, listed by the World Health Organization that account for 80percent of all new TB cases arising each year (WHO 2012: iv).
Health Care Workers	**HCW's**	Referring to individuals working for the Department of Health.

Human Immunodeficiency Virus	**HIV**	HIV is the virus which causes AIDS. Three strains of HIV virus have been identified: HIV-1, HIV-2 and HIV-3 (Dictionary of Medical Terms 2007: 178).
Interferon-gamma Release Assay	**IGRA**	An advanced diagnostic blood test that determines the presence of Mycobacterium Tuberculosis (Mahomed *et al*. 2011: 1).
Isoniazid	**INH**	An anti-tuberculosis compound used in the treatment of tuberculosis (Dictionary of Medical Terms 2007: 207).
Infection and Prevention Control	**IPC**	Methods used to limit the spread of infection using administrative, engineering and personal protective measures (Mehtar 2008 325).
Isoniazid Preventive Therapy	**IPT**	The use of isoniazid to prevent active TB disease. (Menzies, Jahdali and Otaibi 2011: 257).
Kwa-Zulu Natal	**KZN**	One of the nine provinces in South Africa.
Latent Tuberculosis Infection	**LTBI**	Referring to the dormant infection of tuberculosis. Persons with latent TB infection are not infectious and cannot spread TB infection to others (CDC 2010: 1).
Millennium Development Goal	**MDG**	Derived from the Millennium Declaration. Eight goals were adopted by all United Nations Member States in 2000, to be achieved by 2015. The goals aim to combat poverty, hunger and disease, provide education to all children and equal opportunities to women and men, to protect the environment; and to establish a global partnership for development (United Nation 2013: 1).
Multidrug-Resistant Tuberculosis	**MDR-TB**	Resistance to one of the TB drugs, at least rifampicin or isoniazid (WHO 2012: iv).

Mycobacterium Tuberculosis	***MTB***	Part of the genus *Mycobacterium* and a causative agent of most tuberculosis. *Mycobacterium tuberculosis* appears to be genetically diverse and may exist in various strains (Mahon, Lehman and Manuselis 2007: 685).
National Department of Health	**NDoH**	Referring to the South African National Department of Health.
National Health Laboratory Services	**NHLS**	The South African public health laboratory service.
National Tuberculosis Programs	**NTP**	Referring to the TB program developed by South Africa to assist in monitoring the incidence of tuberculosis in the country.
Regional Hospital		Level 2- These provide health services to a defined regional drainage population. At least 5 of the following eight basic specialities need to be provided permanently: surgery, medicine, orthopaedics, paediatrics, obstetrics and gynaecology, psychiatry, diagnostic radiology and anaesthetics (Cullinan 2006: 16).
Tuberculin Skin Test	**TST**	A diagnostic skin test using purified protein derivatives allowing for an inflammatory reaction to indicate presence of MTB (Mahomed *et al*. 2011: 1).
Tuberculosis	**TB**	Referring to the infection in humans caused by *MTB*. The most common form of TB occurs within the lung known as pulmonary tuberculosis, anything outside the lung is known as extrapulmonary tuberculosis (Dictionary of Medical Terms 2007: 429).
World Health Organization	**WHO**	The directing and coordinating authority for health within the United Nations system. It provides global data on tuberculosis.

CHAPTER 1

OVERVIEW OF THE STUDY

1.1 Introduction

The introductory chapter will provide the background of the study, the purpose of the study, the objectives and rationale of the study, the researcher's interest in the study, the assumptions and delimitations of the study and the structure of the dissertation.

1.2 Background of the study

According to Rispel and Barron (2010: 802), the South African government moved into democracy with a "highly fragmented" health care system. The South African Health Review (Department of Health 2013: 90), conducted over the 2012/2013 period, indicates that South Africa currently displays the highest rate of inequality in the world in terms of social, economic and health outcomes. Coovadia*et al.* (2009: 817) state that the unfair distributions of health care workers (HCW's) are noticed in all provinces, especially when comparisons are made between rural and urban; black and white; as well as public and private health sectors. This supports the statements made by Ripsel and Baron (2010: 802).

According to Coovadia*et al*. (2009: 826) the main difference between the public and private sectors in health care is the availability of resources. Overall, 64 percent of the population is entirely dependent on the public sector for all of their health care needs. The report by Coovadia*et al*. (2009) suggests that in order for South Africa to meet the Millennium Development Goal's (MDG's), access to social services needs to be improved, income inequality needs to be addressed and gender equity should be promoted. Even with almost 20 years of democracy, these disparities are still noted regardless of the numerous structural, legislative and policy changes (Ripsel and Baron 2010: 802). The South African Health Review (Department of Health 2013: 130) states that

currently South Africa faces a quadruple burden of disease. The quadruple burden of disease consists of four epidemics, including the infectious diseases [Human-Immunodeficiency Virus (HIV) and Tuberculosis (TB)], chronic diseases, injury as well as maternal and child mortality.

The TB epidemic, in South Africa, has been highlighted globally (World Health Organization 2011a: 11). TB was declared a global health emergency in 1993 (World Health Organization 2013: 1). Since the mid-1990's efforts to improve TB care and control has strengthened. The Directly Observed Treatment Short Course (DOTS) strategy developed by the World Health Organization (WHO) allowed for the national TB programs (NTP's) to document TB cases by recording and reporting them (World Health Organization. 2012: 3). The Centers for Disease Control and Prevention (CDC) further published "*Guidelines for Preventing the Transmission of Mycobacterium Tuberculosis in Health Care Facilities, 2005*"in 1994 and expanded these guidelines over the years to accommodate settings other than hospitals (Centers for Disease Control and Prevention 2005). Despite global targets such as the MDG's being introduced, efforts to improve hospital conditions and hygiene, nosocomial infections, including *Mycobacterium tuberculosis* (*MTB*), still pose a substantial risk to HCW's (World Health Organization 2006: 8). This still remains a global public health concern (Lawn and Zumla 2011: 68).

Wood *et al*. (2011: 111)state that reports made to the WHO by South Africa have indicated that TB notifications have increased five times over the past 20 years. The 2013 Global Tuberculosis Report published by the WHO (2013: 19) indicates that South Africa accounts for one-third of all TB deaths, globally. To date, South Africa has the third highest incidence for TB in the world, after India and China, with approximately 0.4 to 0.6 million cases reported (World Health Organization 2013: 11). With one percent of South Africans developing TB annually (Wood *et al.* 2011: 111), efforts from South Africa saw the release of 10 key priorities for the period 2009 – 2014 (Department of Health 2010a: 3) by

the National Department of Health (NDoH). These priorities, listed in Table 1 below, are intended to assist the country meet the MDG's and monitor improvements in health systems (Department of Health 2010a: 3).

Table 1: The NDoH 10 Point Plan

i	Provision of strategic leadership and creation of a social compact for better health outcomes;
ii	Implementation of National Health Insurance (NHI);
iii	Improving quality of health services;
iv	Overhauling the health care system and improving its management;
v	Improving human resources management, planning and development;
vi	Revitalisation of infrastructure;
vii	Accelerated implementation of HIV & Aids and Sexually Transmitted Infections National Strategic Plan 2007-2011 and increase focus on TB and other communicable diseases;
viii	Mass mobilisation for better health for the population;
ix	Review of the drug policy; and
x	Strengthening research and development.

(Department of Health 2010a: 3)

Priority (vii) of the 10 Point Plan is to accelerate the implementation of the HIV & Aids and Sexually Transmitted Infections National Strategic Plan 2007-2011 and increase focus on TB and other communicable diseases (Department of Health 2010a: 21). In terms of TB management and control, priority (vii) aimed to achieve five goals by 2012/2013. These included a decrease in TB numbers from 341 165 in 2008/2009 to 175 000, a decrease in the defaulter rate to less than five percent, an increase in the cure rate to 80 percent and a decrease in the percentage of drug resistant TB in patients. Priority (vii) relates directly to this research study as the impact of health care associated infections on HCW's has been highlighted in studies by van Rie*et al*. (2013: 853); Sissolak, Bamford and Mehtar (2010: 427); and Joshi *et al.* (2006: 2377); as well as the report

made by the Department of Health – the South African Health Review (Department of Health 2013: 198).

In South Africa, smear microscopy forms the basis of the NTP as the preferred method of TB diagnosis (Sissolak, Bamford and Mehtar 2010: 423). Due to the National Health Laboratory Services (NHLS) being situated at district and regional health care institutions, TB diagnosis is commonly made at these health care levels. Due to limitations of these services at community health centres and clinics, patients are referred to a district or regional hospital, dependent on their residential address, for further medical assistance. Most patients complete their course of diagnosis and treatment, with follow up diagnostic chest radiographs at these higher level facilities. General radiography equipment, available at all district and regional institutions, allow for chest radiography to be performed on all patients requiring these examinations. Most patients do not proceed to tertiary or specialist hospitals unless further care is required; therefore tertiary and TB specialist hospitals were not included in this study.

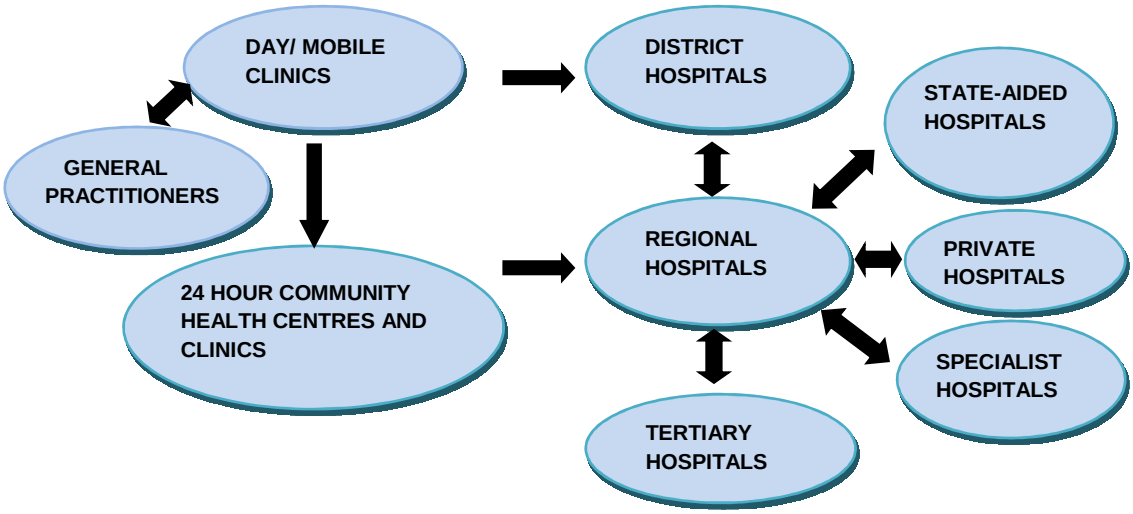

Figure 1: Referral Pattern of Patients to Hospitals for TB Treatment and Care (Department of Health 2003: 5)

In view of the fact that patients are referred to district and regional hospitals for further diagnosis and treatment, including chest x-rays, radiology departments are exposed to patients with varying degrees of infection, increasing the risk of transmission of *MTB* to all radiology staff (Tan and Kamarulzaman2006: 2). Ndjeka, Matji and Ogunbanjo (2008: 46) indicate that *MTB* infection results in either latent tuberculosis infection (LTBI) or active TB disease. Radiology departments comprise of a range of skilled workers, allocated to specific workstations, with various socio-economic and demographic factors, all of which contribute to each individual's risk of LTBI and TB disease. The need for LTBI testing and diagnosis is essential as this will assist in curbing the development of active TB disease, thus reducing the spread of this disease amongst radiology staff. This is essential to prevent the transmission of undetected active TB disease to already compromised radiology staff. The existing shortage of human resources in terms of HCW's is critical in the South African health care system (Coovadia*et al*. 2009: 817) and the need to retain healthy workers is essential.

In South Africa, annual medical screening is no longer a requirement for radiation workers (those working withradiation), as compared to previous years. Currently a pre-employment medical examination, including the chest x-ray, is the only form of medical surveillance (Department of Health, 2010b: 12). The chest x-ray is thus the only diagnostic tool used during radiology staff employment medical exams. According to Joshi *et al*. (2007: 1), radiological screening such as chest radiography is cost effective and suited for active TB disease screening. It is therefore, necessary to consider the prevalence of, as well as the association of demographics and occupational factors with LTBI in radiology staff in order to implement latent tuberculosis screening into the annual medical screening framework of radiology HCW's. This in turn will allow for the treatment of undetected active TB disease, reducing the transmission time to other HCW's and patients. It will also allow for the closer monitoring of

HCW's with LTBI and assist in the detection of LTBI progressing to active TB disease at an early stage.

1.3 Purpose of the study

The aim of this research study was to investigate the association of demographics and occupational factors with LTBI in radiology staff in public sector hospitals of the eThekwini Health district in order to determine the prevalence of LTBI in radiology staff; and identify and describe associations with LTBI. Quantitative methodology and a cross-sectional design were used to undertake a descriptive analysis of the association of demographics and occupational factors with LTBI in radiology staff in public sector hospitals of the eThekwini Health district in order to achieve the objectives listed below.

1.4 Objectives of the study

The objectives of the study were to:

- Determine and describe the prevalence of LTBI in radiology staff employed in radiology departments of public sector hospitals in the eThekwini health district using the TST.

- Describe the demographics and occupational exposure of radiology staff to TB.

- Identify the associations between demographics and occupational exposure with the prevalence of LTBI in radiology staff.

1.5 Rationale of the study

The South African Health Review (Department of Health 2013: 69) recognizes HCW's as a high-risk, vulnerable group for contracting TB. It characterizes TB as a dual threat to HCW's, both as a communicable disease and an occupational health hazard (2013: 130). The need to reduce healthcare associated infections in South Africa is a priority for all healthcare authorities.

Prioritizing active TB and primarily providing Isoniazid Preventative Therapy (IPT) to HIV infected individuals are South Africa's main objectives in order to reduce the high incidence of TB (Van Rooyen and Brink 2007: 108). According to the mid-term progress report of the NDoH 10 point plan (Department of Health 2011a: 24) screening for TB is a key component of the HIV Counseling and Testing (HCT) Campaign due to the high co-infection rates of HIV and TB. LTBI in HIV negative individuals, including HCW's, has become a secondary priority. The need to introduce a screening and monitoring tool for LTBI is required in order to prevent the development of active TB disease in HCW's that are latently infected. It is hoped that this will result in a more complex, but effective method of medical screening with regard to TB in HCW's and in particular radiology staff. HCW's will be provided with the knowledge of whether they are at risk of developing active TB disease, allowing them to make decisions with regard to treatment, if HIV positive, and prevention options. Further diagnostic methods to rule out active TB disease may be introduced, where HCW's test positive for LTBI, and IPT can be suggested in cases where HCW's are also HIV positive. Monitoring of HCW's that are latently affected but HIV negative is essential in order to reduce the risk of reactivation of TB.

1.6 The researcher's interest in the study

The researcher has been working at a public institution in Kwa-Zulu Natal (KZN) since the start of her career as a diagnostic radiographer in 2006. The alarming lack of infection control measures and ventilation problems initially sparked her interest in airborne infections, particularly *MTB*, in the radiology department. In a report issued by the Ministry of Health, Dr Aaron Motsoaledi stated that the eThekwini health district of Kwa-Zulu Natal (KZN) displayed the highest incidence of TB cases in the country (Department of Health 2011b: 1). Dludla and Bateman (2012: 649) also state that KZN displays the highest incidence of drug resistant TB in the country. With more and more co-workers developing TB disease, the problem was evident. However, socio-economic and demographic factors; and occupational exposure could not be ruled out as risk factors for

some staff. A lack of research relating to radiology departments in general further motivated the researcher to undertake a research study of this nature. The study was limited to the eThekwini health district of KZN. This was primarily due to the high rates of TB incidence in this area and the accessibility to radiology staff.

1.7 Assumptions and delimitations of the study

The following **assumptions** were made:

- All radiology staff would be willing to participate in order to obtain proportional data.

- All staff that qualified for phase two of the study would continue to have the TST performed due to detailed explanations of the study provided to them prior to commencement of phase one.

The **delimitations** of the study were as follows:

- The study was limited to district and regional hospitals in the eThekwini health district of KZN. The eThekwini health district was chosen due to significant statistics of TB amongst HCW's within this district. Tertiary and specialist hospitals were excluded due to limitations in funding and difficulty obtaining access to these radiology departments.

- The study was limited to radiology departments since the researcher is a diagnostic radiographer with a particular interest in this area. With fellow diagnostic radiographers and support staff increasingly becoming infected with TB, the need for research in this area was noted. A paucity of literature about health care associated infections in radiology departments further encouraged the researcher to limit the study to this department only.

1.8 Structure of the dissertation

The structure of this dissertation is as follows:

- Chapter 1 provides the study background, the aims and objectives, the purpose, the rationale of the study and the assumptions and limitations of the study.

- Chapter 2 presents a literature review for the association of demographics and occupational factors with LTBI in radiology staff, focusing on the objectives outlined in chapter 1.

- Chapter 3 discusses the methodology used in the research study, including the research design, data collection methods and analysis, sampling, population, inclusion and exclusion criteria, reliability and validity, problems encountered, limitations and ethical considerations.

- Chapter 4 presents a comprehensive descriptive and inferential analysis which is shown in Tables or Figures.

- Chapter 5 discusses the findings of the study in terms of associations of LTBI with demographics and occupational factors.

- Chapter 6 provides the conclusion and recommendations of the study.

CHAPTER 2

2.1 Introduction

TB remains a leading cause of death globally, second only to HIV (O' Donnell *et al.* 2011: 1942). With an increasing population in South Africa, already a high TB burden country (HBC), the threat of TB transmission to HCW's is evident (World Health Organization 2011a: 16).

Human expiratory activities generate bio-aerosols into the environment. Collections of airborne biological material increase levels of airborne infection. Once a susceptible host inhales a droplet nucleus, containing *MTB*, infection begins in the alveoli of the lungs and droplet infection occurs. (Morawska*et al.* 2009: 256). According to Ndjeka, Matji and Ogunbanjo (2008: 46), in individuals with compromised immunity, droplet infection may lead to active TB disease. In other circumstances where an immune response to droplet infection occurs, bacterial activity is limited. However, some bacteria survive and remain dormant but viable for many years. This is referred to as LTBI (Ndjeka, Matji and Ogunbanjo, 2008: 46).

Zungu and Malotle (2011: 17) state that South African HCW's are exposed to environments with a high concentration of TB patients. The South African Health Review (Department of Health 2013: 199) suggests that the lack of adequate infection control measures and trained staff in infection prevention and control, further contribute to the transmission of infections. O' Donnell *et al*. (2010: 520) agree that a lack of focus on infection control at non-specialist TB hospitals in KZN may be a contributing factor to the rate of multi-drug resistant (MDR-TB) and extensively drug resistant tuberculosis (XDR-TB) hospitalizations of HCW's in KZN. HCW's themselves suggested that the barriers to TB infection control in South Africa are mainly due to uncomfortable

respirators, non-proactive use of the respirators, training deficits, inadequate ventilation parameters and the lack of a shared responsibility by HCW's in terms of committing to the health care facilities infection control committee policies (Department of Health 2013: 199). Due to daily exposure to infected patients, diagnostic radiographers are at a high risk of *MTB* exposure (Tan and Kamarulzaman 2006: 2) and therefore infection.

Schablon*et al.* (2010: 1) state that the risk of LTBI and active TB disease are well established occupational diseases in HCW's. The early diagnosis of LTBI is essential in controlling and eliminating TB, as treatment reduces the risk of LTBI progressing into active TB disease (Costa *et al.* 2010: 2). It is therefore, necessary to determine the presence of LTBI in staff. According to Costa *et al.* (2010: 2), the traditional method of *MTB* testing is the TST, used in this study to test radiology staff. However, Costa *et al.* (2010: 2) state that developments in molecular biology have introduced the interferon-gamma release assays (IGRA's) for LTB testing. The IGRA being highly expensive in South Africa and available only in the private sector hospitals makes diagnosis of LTBI using the IGRA costly.

The need to screen HCW's regularly is imperative in order to curb the TB incidence. It is necessary however, to consider factors other than occupational exposure of HCW's to TB, especially in high incidence settings such as South Africa. With South Africa recognized as a HBC for TB disease, HCW's are at risk of acquiring infections from the communities in which they reside. The WHO (2013: 15) states that South Africa has an incidence rate of over 500 cases of TB per 100 000, in comparison to the Region of the Americas which has an incidence rate of 50 cases per 100 000. With the estimate made by the WHO (2013: 15) that one in every one-hundred South Africans will acquire TB each year, the probability of a community acquired infection is high. Demographic factors, medical history and social history were included in this study, as all of these factors play a role in the risk of transmission of TB in HCW's.

2.2 Disease profile in South Africa

In 1993 the WHO declared TB a public health emergency (World Health Organization 2013: 1) and since then, ongoing efforts have been made to curb the incidence and mortality rates of TB. Global targets set by the United Nations and the WHO, with regard to the MDG's and the Stop TB Partnership, respectively, have been established to reduce the TB burden globally (World Health Organization 2011b: 3). The sixth MDG aims to combat HIV/AIDS, malaria and other diseases. The MDG [Goal 6, Target 8(14)], which was developed as a medium-term goal, aims to have halted or begun to reverse the incidence of TB by 2015 (World Health Organization 2006: 8). The long-term goal set by the Stop TB Partnership aims to halve TB deaths as compared to the 1990 levels by 2015 and by 2050 to have one case in one million people (World Health Organization 2011b: 12).

South Africa depends highly on the efficient use of national resources by government and other stakeholders in order to meet the MDG's (Department of Health 2010c: 3). The Millennium Development Goals Country Report 2010 published by South Africa, stated that whilst South Africa had reached some MDG's more than five years ahead of 2015, on the other extreme, some goals were far from being achieved. The Millennium Development Goals Country Report (Department of Health 2010c: 76) illustrates the target achievability of goal 6 (Combat HIV/AIDS, Malaria and Other Diseases). Table 2 presents statistics taken from the Millennium Development Goals Country Report (Department of Health 2010c: 76). These statistics indicate the target achievability of the MDG's and a comparison of TB statistics from baseline years and years closest to 2010.

Table 2: Millennium Development Goal Target Achievability

Goal and Indicators	1994 Baseline (or closest year)	Status 2010 (or nearest year)	2015 Target	Target Achievability	Indicator Type
	2000	2009			
• Incidence of tuberculosis per 100 000 population	253 *(2004)*	283 *(2009)*	< 253	Unlikely	MDG
• Prevalence of Tuberculosis	134 000 *(2004)*	144 000 *(2008)*	< 134 000	Unlikely	MDG
• Death rates associated with tuberculosis per 100 000 population	147 *(2002)*	179 *(2007)*	< 147	Unlikely	MDG
Proportion of tuberculosis cases detected and cured under directly observed treatment short course	65.5% *(2004)*	76.4% *(2008)*	100	Possible	MDG

(Department of Health 2010c: 76)

The 2015 targets are set at the level of baseline statistics as seen above. A comparison of these years indicates an increase in all statistics. The MDG {Goal 6, Target 8(14)}, aims to have halted or begun to reverse the incidence of TB by 2015 (World Health Organization 2006: 8), therefore target achievability is very unlikely. The “possibility” of reaching the MDG target of 85 percent however still seems unlikely. Even though the Millennium Development Goals Country Report (Department of Health 2010c: 76) indicates a possibility of achieving the target of 85 percent due to the positive trends that have been displayed over the years, the WHO (2013: 38) has reported that South Africa has only reached a target of 79 percent which has not improved since 2010. With an average population of 52, 98 million people and an HIV prevalence of 10 percent (Statistics South Africa 2013: 2), South Africa seems unlikely to reach the target goals set by both the United Nations and the WHO.

According to the WHO Global TB report (2012), the global burden of TB still remains enormous. African countries accounted for 24 percent of 5.8 million cases of TB that were notified in 2011. South Africa contributed one-quarter of the 24 percent of these cases (World Health Organization 2012: 30). Amongst the 22 HBC's, outlined by the WHO, South Africa is the only country that displayed an increasing rate of TB in 2010, whilst other HBC's stabilized or decreased their TB rates (World Health Organization 2011a: 12). In 2013, the WHO (2013: 19) reported that 75percent of the TB deaths were noted to have occurred in the African and South-East Asia Regions. India and South Africa accounted for a third of these deaths. In comparison to regions such as the Americas, Western Pacific and Eastern Mediterranean which have already reached the 2015 targets, South Africa seems unlikely to reach these targets due to the inconsistent mortality trends noted. This indicates that globally, South Africa is not performing as well as other countries.

According to Fourie (2011: 2), the TB epidemic in South Africa is primarily due to the lack of effective TB management systems. With the focus of the NTP being the DOTS services, the nosocomial transmission of the disease has been neglected. The impact of TB and HIV co-infection in South Africa, especially in provinces such as KZN, Mpumulanga and Gauteng has resulted in TB rates in these areas increasing drastically.

In 2006, South Africa became the focus of international attention when the first documented case of XDR-TB was reported at the Tugela Ferry Hospital in KZN (Cooke *et al*. 2011: 2035). The WHO (2013: 52) reported that these patients were all HIV positive and most died very quickly. South Africa remains the country that reports the most XDR-TB cases in the world and annual notifications have increased from 467 in 2009 to 1596 in 2012 (World Health Organization 2013: 52). MDR-TB and XDR-TB in KZN has been reported in clusters since 2006 (Fourie 2011: 2).

Gandhi *et al.* (2010: 1831) also states that a high early mortality rate, within the first two months prior to diagnosis and commencement of treatment is noted in low income settings where MDR- and XDR-TB co-exists with HIV infection. The WHO (2013: 52) states that more than half of the 83 715 MDR-TB cases reported globally in 2012 are from South Africa and about 10 percent of these MDR-TB cases reported have XDR-TB. South Africa was one of the countries that reported almost 100 percent of TB patients to have MDR-TB in 2012 (World Health Organization 2013: 54). The treatment outcomes reported by South Africa are unfavourable. Klopper *et al.* (2013: 453) suggests that the absence of routine drug susceptibility testing of second-line drugs and the treatment of MDR-TB may have resulted in inappropriate treatments of pre-XDR TB cases and resulted in prolonged infectiousness of the host.

Van Rooyen and Brink (2007: 107) state that South Africa displays both high and low prevalence groups, requiring an encompassing approach to *MTB* diagnosis. Low incidence settings allow priority to be given to the detection and treatment of LTBI and overall TB control. This however, is not done in low incidence settings in South Africa due to the overall high burden of disease in the country and the main priority of LTBI treatment given to HIV infected individuals and children (Department of Health 2012a: 44). It is necessary in South Africa to give priority to the diagnosis and treatment of active TB disease due to the overall high prevalence of TB. In a report issued on 24 March 2011, by the Ministry of Health, Dr Aaron Motsoaledi stated that the eThekwini District of KZN displayed the highest incidence of TB cases in the country (Department of Health 2011b: 1). Due to KZN being the region where this study was conducted, acknowledging the TB incidence and treatment priorities was necessary to ensure a full understanding of the status of the HCW's in this region.

With the growing statistics, noted above, it is essential for all HCW's and authorities to recognize the need for screening of LTBI (Zungu and Malotle

2011: 17). This will hopefully result in a more complex, but effective method of medical screening with regard to TB in HCW's and in particular radiology staff. Prioritizing the need to detect active TB at an early stage is an essential step to reducing the rates of transmission from an undiagnosed and untreated host to other HCW's and patients. Zungu and Malotle (2011: 20) state that, regardless of South Africa having progressive legislation with regard to workers' health, the need to reinforce the Occupational Health and Safety Act by the Department of Labour is necessary. The South African healthcare system cannot afford to lose its human resources to TB, especially highly skilled personnel, when it already faces a shortage in this respect, especially in radiology departments.

2.3. Prevalence of Tuberculosis in Health Care Workers

The South African Health Review (Department of Health 2013: 198) states that hospital settings promote the risk of TB transmission to both patients and HCW's. This characterizes TB as a dual threat in healthcare facilities: as a communicable disease and as an occupational health hazard. South African hospitals are faced with large numbers of patients seeking treatment at health facilities (Finlay *et al*. 2012: 2). Zungu and Malotle (2011: 17), state that South African HCW's are challenged with shortages of staff, deteriorating healthcare infrastructures, an increasing population with a high burden of communicable diseases and a lack of resources. In 2008, a study by conducted in KZN by Parikh and Veenstra (2008: 468) indicated that outpatient departments are not only faced with an increase in burden of disease, but rather an increase in resource burden, making the situation difficult for existing HCW's.

TB is recognized as a healthcare associated infection(Whitaker *et al*. 2013: 1). The South African Health Review (Department of Health 2013: 69) indicates that the incidence of TB in HCW's is higher than the general population. A study by University Research Co. LLC (URC) and the Desmond Tutu Tuberculosis Centre found that HCW's in South Africa are three times more likely to acquire TB than the general population, with the average incidence of TB amongst

HCW being two percent and the general population being 0.9 percent (Tuberculosis in Healthcare workers: *Findings from South Africa* 2008: 2).
In KZN, HCW's are two times more likely to acquire drug resistant TB as compared to HCW's from other provinces (Dludla and Bateman 2012: 649). Zungu and Malotle (2011: 18) state that a possible reason for the high incidence of TB amongst HCW's may be due to the generalized high incidence noted in the South African population. In India, a study by Pai and Christopher (2011: 198) indicated that due to exposure to high incidences of TB, HCW's showed a lack of concern when they contract TB themselves. This study noted that it is more likely for HCW's, in HIV prevalent regions, to be hospitalized with MDR-TB or XDR-TB rather than non-HCW's. This can be related to South African HCW's, as the HIV epidemic is extensive in South Africa, which makes South African HCW's more likely to be hospitalized with drug resistant TB. This is supported by O' Donnell *et al*. (2010: 520) who found that HCW's in KZN were five to six times more likely to be hospitalized with MDR- or XDR-TB when compared to non- HCW's.

Sissolak, Bamford and Mehtar (2010: 427) state that in South Africa, the extent of healthcare associated infections is unknown due to only a few tertiary institutions implementing a surveillance program. Another factor contributing to the lack of data was the possibility that only a few small scale studies had been conducted thus far in South Africa, making these efforts insufficient to quantify the problem or evaluate the risk factors associated with TB (Department of Health 2013: 69).

A systematic review of TB among HCWs in low and middle income countries, including South Africa, reported a prevalence of LTBI of 54 percent (range 33-79 percent) using the TST (Joshi *et al.* 2006: 2376). In another study by Joshi *et al*. (2007:1) findings indicated that in regions with high TB incidences, abnormal chest radiography findings were noted in HCW's that tested positive for LTBI. Almost two-thirds of their study population tested positive for LTBI. The

abnormal radiographic findings could not be specifically related to TB infection; however these HCW's required investigative procedures. The risk of infection to radiology HCW's can be assumed due to high infection rates in not only patients but other HCW's passing through the department. This also reinforces the need to implement a more complex medical screening system in order to identify undetected active TB disease at an early stage and thus confirmed the need for this study.

2.4 Occupational factors associated with TB in Health Care Workers

The CDC Morbidity and Mortality Weekly Report (MMWR) states that unrecognized TB disease is the most important risk factor for the transmission of TB in a health care setting (Centers for Disease Control and Prevention 2005: 6). In two South African studies (Sissolak, Bamford and Mehtar 2010: 427) and (Naidoo and Jinabhai 2006: 680) it was thought that the transmission of TB to HCW's were under-estimated, possibly due to the under-reporting of cases to Occupational Health Clinics. Naidoo and Jinabhai (2006: 680) commented that some HCW's may seek treatment outside their hospitals whilst Sissolak, Bamford and Mehtar (2010: 427) thought that the fear of stigmatization could be a driving factor.

Studies performed worldwide, including South Africa, have indicated the occupational and demographic risk factors for TB and LTBI. Schablon*et al. (*2010: 3) concluded that in Germany, LTBI was more prevalent in older HCW's with a longer duration of employment and those with an increased occupational exposure to TB. This is supported by studies conducted by Mathew *et al.* (2013: 70) in South India; He *et al*. (2010: 4) in China; Demkow*et al.* (2008: 214) in Poland; and Joshi *et al.* (2006: 2381) that conducted a systematic review including 51 studies performed in low- and middle-income countries. According to Joshi *et al.* (2006: 2376), the occupational risk of acquiring TB is associated with the level of occupational TB exposure. Studies performed in Spain by Casas *et al*. (2013: 606) and Demkow*et al.* (2008: 211) indicate that LTBI

appears to be higher in HCWs with a high risk of exposure in TB-related departments compared to those with a low risk of exposure. Therefore, certain work locations and occupational categories can be considered high risk categories due a higher occupational exposure to TB patients than other staff (Joshi *et al.* 2006).

Studies from South Africa have indicated that paramedical staff, including radiographers and patient attendants, have the highest mean incidence of TB disease in the health-care environment (Naidoo and Jinabhai 2006: 679) and (Joshi *et al.* 2006: 2385). Some studies have indicated that the lowest TB incidence was in administrative staff (Joshi *et al.* 2006: 2385), (Demkow*et al.* 2008: 214); and (He *et al.* 2010: 4).

2.4.1 Occupational exposure in the radiology department

According to Franchi*et al.* (2007: 537) the probability of infection depends highly on the site of disease and bacillary burden in the infectious patient, the duration and proximity of contact with the infectious patient, the characteristics of the surrounding air volume, and the speed of replacement of air through ventilation. These principles are the same for drug resistant strains (Franchi*et al.* 2007: 537). Despite studies being conducted in South Africa with regard to LTBI in HCW's (van Rie*et al.* 2013) and (Sissolak Bamford and Mehtar 2010), radiology departments have not been the focus. It was therefore necessary to determine the association of occupational LTBI in radiology staff.

Tan and Kamarulzaman (2006: 2) state that radiology departments comprise a range of skilled workers, allocated to specific workstations, with various socio-economic and demographic factors, all of which contribute to each individual's risk of LTBI and TB disease. The categories of staff operational in the radiology departments of the eThekwini Health District consisted of diagnostic radiographers, administrative clerks, darkroom attendants, patient attendants, general orderlies, radiologists, student radiographers and nursing staff.

According to Üstünsöz (2005: 5) the direct contact between patients and radiology HCW's is required in order to perform diagnostic examinations.Chingarande and Chidakwa (2014: 20) state that diagnostic radiographers are required to visit various outpatient areas and wards found within the hospital setting to perform radiography examinations. The possibility for TB transmission both to and from the radiographer is high. As a host, the radiographer may transmit infection to patients and other HCW's and as a victim, the radiographer may become susceptible when passing through high TB burden areas. Huang *et al.* (2007: 521), state that studies performed have noted that the short periods of contact with active TB patients during radiological examinations indicate a high risk of infection to radiology staff due to the ability of the droplet nuclei to remain suspended in air currents for several hours.

The general designs of radiology departments promote the transmission of *MTB*. These include various rooms with poor ventilation systems, a lack of natural ventilation and usually a single point of entry and exit (Huang *et al.* 2007: 521). Üstünsöz (2005: 5) states that most health care facilities have a single radiology department with large, immovable and re-usable instruments and equipment. The range of patients, including intensive care unit (ICU) patients, brought into the radiology department for diagnostic procedures results in further risk of transmission of infection, from both patient to patient and from patient to HCW and vice versa. Huang *et al.* (2007: 521), state that with a large number of patients requiring numerous chest x-rays, for the pre-chemotherapy, therapy and post-chemotherapy phases of TB, diagnostic radiographers are in close contact with TB patients on a daily basis. This increases the risk of transmission of nosocomial infections, including *MTB*, to diagnostic radiographers and other radiology staff.

Mohammed *et al*. (2004: 794) recommends the limitation of chest radiography to symptomatic patients and non-productive or smear-negative sputum patients.

This however, is not practiced as the norm. As a practicing diagnostic radiographer, the researcher, has observed patients being sent for chest x-rays with empty sputum collection bottles in hand. Sissolak, Bamford and Mehtar (2010: 424) indicate that the greatest potential to transmit TB occurs at the pre-chemotherapy phase, making radiology staff face a higher risk when encountering these patients. This risk however, does not only end at the pre-chemotherapy phase. Patients are considered infectious for at least a week after beginning treatment; and in patients with drug resistant TB, this time frame is extended (Sissolak, Bamford and Mehtar 2010: 424). Joshi *et al*. (2007: 1) states that chest radiography for TB lacks specificity, supporting the recommendation made by Mohammed *et al*. (2004: 794). Radiographic lesions interpreted as TB lesions may display the same characteristics seen in lesions suggestive of histoplasmosis, tropical eosinophilia, pneumoconiosis, siderosis, sarcoidosis, hypersensitivity pneumonitis and vasculitis. A reduction in the number of chest radiographs will reduce the number of potential TB transmissions within the department, by reducing the overall number of patients.

According to Chingarande and Chidakwa (2014: 18) resource constrained settings promote the potential to transmit nosocomial infections in radiology departments. This is due to long waiting hours for infectious patients because of staff shortages resulting in overworked diagnostic radiographers. In these resource-constrained settings, diagnostic radiographers commit to core responsibilities rather than focusing on areas such as infection control. A study performed in Turkey by Üstünsöz (2005: 5) found that radiology physicians, nurses and technicians (diagnostic radiographers) commonly lacked adequate training in asepsis and antisepsis techniques. In Turkey, radiographers are not professionally educated in these areas during their tertiary education, thus making the radiology department a higher risk area for the transmission of infections including *MTB* (Üstünsöz 2005: 5). In South Africa, however, diagnostic radiographers have been trained in these techniques during their formal education and training. This however has not been reinforced post-

employment. The South African Health Review (Department of Health 2013: 200) lists the lack of in-service training as a barrier to TB infection control programs (ICP) in hospitals.

2.4.2 Infection control in hospital settings and radiology departments

The transmission of TB is highly dependent on infection control measures, namely, administrative (level 1), environmental (level 2) and personal protective measures (level 3), as discussed below (Mehtar 2008: 326). The main source of Infection and Prevention Control (IPC) guidelines for tuberculosis is sourced from the CDC in the United States of America (U.S.A.). Due to major economic differences, a lack of resources, infrastructure, technology, overcrowding, poor management, inadequate hygiene, poor functioning laboratory services and a shortage of trained staff, the IPC Guidelines for tuberculosis are difficult to administer and sustain in South Africa (Mehtar 2008: 325). Bock *et al.* (2007: 110) state that even though aspects of infection control may differ between wards and outpatient departments, the objectives and approaches to infection control remain the same. According to Visser*et al.* (2011: 591) drug resistance in South Africa increases the urgency of ensuring that recommended infection control measures are implemented. The limitation of hospital admissions, the use of natural ventilation, N95 masks and active case findings could substantially curb transmission.

a) Level 1 - Administrative measures

Administrative controls reduce the risk of exposure, infection and disease through policy and practice(Department of Health 2007: 5).South Africa has developed The Draft National Infection Prevention and Control Policy for TB, MDR-TB and XDR-TB to “help management and staff minimize the risk of TB transmission in health care facilities and other facilities where the risk of transmission of TB may be high due to high prevalence of both diagnosed and undiagnosed TB such as prisons” (Department of Health 2007: 5). This policy aims to provide directives with regard to TB transmission and IPC in health care

facilities, drug rehabilitation centres, correctional institutions and other facilities with large congregate settings of HIV and TB infected individuals. It also aims to protect HCW's through HIV voluntary counseling and testing, increasing awareness of TB in staff and preventive action; and address issues of MDR TB.

Sissolak, Bamford and Mehtar (2010: 423) state that in South Africa, it is the responsibility of individual health care facilities to develop their own IPC guidelines. Visser*et al*. (2011:591), support the statement that South African facilities adapt national or provincial guidelines to implement them within the hospitals. However, whether these policies are adhered to, how often they are updated or how accessible the policies are to staff is unknown (Visser*et al*. 2011:591).

The National Core Standards for Health Establishments in South Africa were developed to monitor the quality of care and service delivery; and act as a guide to all staff, managers and the public (Department of Health 2011c: 8). The standards set within the seven domains require compliance from all establishments, both public and private sectors. Six critical areas requiring improvement and compliance, especially in the public sector, have been identified. This includes IPC. A directive found in the second domain indicates that an IPC policy should be implemented in order to reduce health care associated infections. This policy should outline the approach that the hospital would use with regard to managing health care associated infections. It instructs that a qualified health care professional is in charge and responsible for IPC; that a system is in place for the monitoring and reporting of infections; a system is in place for monitoring IPC and corrective actions are used when necessary; all infections and notifiable diseases are reported to the appropriate departments; and all staff, patients and caregivers are educated on IPC practices. Respiratory health is reinforced by ensuring that precautions are taken to prevent the spread of infection via air. Programmes relating to specific disease such as TB exist (Department of Health 2011c: 23).

In 2007, an inter-professional training seminar held in Cape Town, brought together HCW's including physicians, nurses, hospital managers and community health workers to address safety issues and identify strengths and weaknesses in Infection Control policies and procedures seen in South Africa. The report prepared by Ghebrehiwet, Anazonwu and Seyer (2008) indicated barriers relating to administrative, engineering and personal protective measures. Administrative barriers included the lack of integration and communication between different hospital departments, poor health worker surveillance systems and a difficulty accessing TB screening services. Outpatient and radiology departments, laboratories and general wards were notified as the highest risk departments for a lack of administrative controls (Ghebrehiwet, Anazonwu and Seyer 2008: 4).

Visser*et al.* (2011: 592) states that IPC in public sector hospitals are controlled by nursing management. Due to varying standards at each hospital and different adaptations of the national guidelines, diverse IPC guidelines are seen at each hospital. Radiology departments are often neglected in TB infection control programs and IPC guidelines of the hospital may be irrelevant to the radiology department (Tan and Kamarulzaman 2006: 1). With adapted or non-existent IPC guidelines, IPC in radiology departments may suffer due to the number, variety of patients and the time they spend in this department (Tan and Kamarulzaman 2006: 2). Tan and Kamarulzaman (2006: 1) recommend specific standardized guidelines on preventative measures for ambulatory care settings, including radiology departments and clinics. These guidelines should be developed to enable HCW's working in those areas to reduce the risk of infection. Üstünsöz (2005: 5) supports this statement in saying that radiology departments do not have standards for controlling hospital infections.

A lack of political will was also noted as a challenge in the report by Ghebrehiwet, Anazonwu and Seyer (2008: 4). Infection Control was not perceived as a priority for national and provincial Departments' of Health. As a

result, the allocation of resources for infection control is compromised and insufficient budgets are allocated. As stated by Chingarande and Chidakwa (2014: 18), resource limitations impact on the output and attitudes of HCW's. The lack of resources includes adequate engineering and environmental controls.

b) Level 2 - Environmental and engineering controls

Environmental and engineering controls aim to reduce the concentration of infectious bacilli in air in areas where contamination of air occurs (Eames *et al.* 2009: 699). According to the CDC (2005: 7) airborne infection control strives to reduce aerosol production, sterilize the bacterial load and prevent the inhalation of droplet nuclei. Environmental and engineering controls are further subdivided into primary and secondary controls. The primary controls use local exhaust ventilation methods, by diluting and removing contaminated air. Secondary controls manage the airflow to prevent contamination of air to areas adjacent to the contaminated area (Centers for Disease Control and Prevention 2005: 7).

Gandhi *et al.* (2010: 1834) state that in most of the world, patients are admitted to large congregate hospital wards or spend time in crowded outpatient waiting areas with little or no ventilation. Modeling studies have shown that when a patient with infectious drug-resistant TB is admitted to such a setting, up to 50 percent of the patients exposed in that ward can become infected within 24 hours. Radiology departments are exposed to large and constant patient volumes (Tan and Kamarulzaman 2006: 2) and staff finds themselves remaining within the department for the entire work day. Infectious patients may compromise indoor air quality resulting in short-range and long-range transmission of *MTB* (Eames *et al.* 2009: 698).

Eames *et al.* (2009: 698) state that droplet nuclei are formed once most of the liquid from the bio aerosol of *MTB* has evaporated, leaving behind its pathogen-containing residue (Eames *et al.* 2009: 698). Large droplets (>100 micrometers)

cause short-range transmission of *MTB*, occurring between individuals within a distance of one metre of each other - the majority of all respiratory droplets become droplet nuclei due to most respiratory droplets being less than 100 micrometres (Eames *et al.* 2009: 698). Tang *et al*. (2006: 101) states that small droplets and droplet nuclei have a long range of transmission and may be infectious to an entire room, department or building. This makes not only diagnostic radiographers, who are in close proximity to the patient, susceptible to acquiring *MTB* but also other radiology staff that may be allocated to distant work stations.

In South Africa, under Section 43 of the Occupational health and Safety Act, 1993 (Act no. 85 of 1993), the Hazardous Biological Agents Regulations were developed in order to protect employees in terms of exposure to hazardous biological agents in the workplace. In these regulations, a hazardous biological agent refers to any micro-organism, cell culture or human endoparasite that may cause any infection, allergy or toxicity, resulting in a hazard to human health (South Africa 1993). The maintenance of environmental controls are outlined in the Hazardous Biological Agents Regulations, indicating that all equipment should be, maintained and in good working order; and examinations of engineering control measures should be performed every 24 months by a recognized inspection authority (South Africa 1993: 28)

According to Bolashikov and Melikov (2009: 1379), natural ventilation should be used. The use of open windows and doors in areas with no central air conditioning is recommended. Qian *et al*. (2010: 560) states that natural ventilation delivers a higher ventilation rate, therefore having a higher dilution capability of infectious bio aerosols. The major environmental control barriers in South Africa, reported by Ghebrehiwet, Anazonwu and Seyer (2008) was the lack of knowledge in terms of environmental control. Ghebrehiwet, Anazonwu and Seyer (2008) also indicated that the use of natural ventilation posed a problem due to the unpredictability of the weather. Windows needed to be

closed for bad weather, security reasons or a lack of blankets to ensure that patients were kept warm whilst windows were opened.

Qian *et al*. (2010: 560) recommends ultra-violet germicidal irradiation (UVGI) and filtration via High Efficiency Particulate Air (HEPA) filters as the gold standard, however, due to resource constraints, these are not available to most hospitals in South Africa. This was another barrier reported by Ghebrehiwet, Anazonwu and Seyer (2008: 5). Most facilities in South Africa had ceilings that were too low to install UVGI units and the affordability of these units as well as HEPA air filters depended on the facility. Aside from filtration and germicidal systems being expensive in South Africa, the lack of technical knowledge for maintenance of these systems was also noted. Sissolak, Bamford and Mehtar (2010: 427) state that the lack of funds in healthcare facilities was a determining factor in environmental control barriers, as some facilities could not even afford extractor fan. With minimal protection within departments, it is necessary for HCW's to make infection control a personal priority.

c) Level 3 - Personal protective measures

According to Eames *et al.* (2009: 699) personal measures are directed towards HCW's; and patients as well as visitors. These measures include hand-washing, reduced physical contact and the wearing of masks or respirators. According to Schweon (2009: 13) respiratory etiquette is recommended for staff that work in environments with contaminated air. The use of N95 particulate respirators is recommended. These respirators have the ability to filter particles up to 1µm in size and contain filters with an efficiency of at least 95 percent (Tan and Kamarulzaman 2006:3).

A report by Ghebrehiwet, Anazonwu and Seyer (2008) indicated that the personal respiratory protective measures displayed barriers of their own. The lack of policies and procedures for the proper use of respiratory protectors such as the N95 respirator was noted in South Africa.Schweon (2009: 17) states that

it is imperative that HCW's wear N95 respirator or a higher rated respirator. The lack of these respirators in some institutions was noted by (Ghebrehiwet, Anazonwu and Seyer 2008: 6). The South African Health Review (Department of Health 2013: 199) indicated that HCW's found that the respirators were either too small or large for use, uncomfortable and stuffy to wear for extended periods of time and the smell of the respirators also presented as a deterrent. These are factors that affect all HCW's, including radiology staff that are required to deal with infectious patients throughout their working day. Bock *et al.* (2007: 110) state that the protection of HCW's depends highly on respiratory protection, however, formal training in the use of these respirators are recommended only when performing high-risk procedures such as a bronchoscopy, the collection of sputum or sputum induction and or post-mortem procedures.

The risk of encountering an infectious patient is a reality for South African HCW's due to the overall high prevalence of TB and HIV in the country (Bock *et al.* 2007 109). This risk is increased when HCW's are immunocompromised or exposed to these individuals outside the hospital setting. It is therefore necessary to consider demographic factors of HCW's as risk factors for TB infection.

2.5. Demographic factors associated with TB in Health Care Workers

Demkow*et al.* (2008: 209) indicate that both occupational exposure and demographic factors are associated with LTBI in various categories of HCW's.This study assessed basic demographics such as age, gender and race. Other demographic factors included medical history, living conditions, socio-economic factors and family life.

According to Harling, Ehrlich and Myer (2008: 492), TB is traditionally regarded as a disease of poverty and low socio-economic status. According to the South African Living Conditions Survey conducted during the 2008-2009 period, an

estimated 52.3 percent people live below the upper-bound poverty line. Kwa-Zulu Natal has the second largest population of 10.5 million people (19.7 percent), is the third poorest province with regard to the food poverty line and the fourth poorest province with regard to the upper-bound poverty line (Statistics South Africa 2012: 11). The eThekwini District displays multi-dimensional income groups with varying levels of social inequality.According to the MDG Report 2013- *Assessing Progress in Africa toward the Millennium Development Goals* (United Nations 2013: 3), urban poverty has now become an issue in South Africa.

Malnutrition and overcrowding are household risk factors (Lönnroth*et al*. 2009: 2244). The associations between TB incidence rates and areas of low levels of education, high levels of poverty, poor government social support, social deprivation and income inequality have been highlighted by the South African Health Review (Department of Health 2013: 99). Lönnroth*et al.* (2009: 2244) state that direct increased exposure to a person with active TB disease, either in a household or community is a proximate risk factor. Morrison, Pai and Hopewell (2008) conducted a systematic review determining the risk of LTBI and active TB disease in close contacts of people with pulmonary tuberculosis in low- and middle-income countries. The findings of their review (2008: 359) stated that closeness of contact and duration of exposure to infectious sources are some of the factors that govern the transmission of *MTB*. Rafiza, Rampal and Tahir (2011: 3) support this and state that living in the same house-hold as a person with active TB increases the risk of TB transmission to other family members. House-hold contacts are considered a high risk population for LTBI and active TB disease (Morrison, Pai and Hopewell 2008: 359). Augustynowicz-Kopéc*et al.* (2012: 597) support this statement made by Morrison, Pai and Hopewell (2008: 359).

Morrison, Pai and Hopewell (2008: 359) also state that it is important to medically assess people who may be infected with *MTB* due to the risk of infection progressing to active disease. In low-incidence settings, house-hold

contact investigation is important in TB control. This allows for family members to be assessed for TB infection. In South Africa however, house-hold contact investigation is not done, primarily due to the overall high burden of disease, the cost of conducting this investigation and the fact that it is considered low priority (Morrison, Pai and Hopewell 2008: 365).

Wood *et al.* (2011: 114) states that reducing the time period of infectiousness of a TB individual, directly affects the prevalence of infectious TB. Increased duration of infectiousness may be due to delays in health-seeking behavior of the infected individual, health systems and diagnostic delays and ineffective treatment or a delay in commencing effective treatment. Scott, Azevedo and Caldwell (2012: 839) support the need for timely access to health services in South Africa, as this in turn reduces the infectious load in communities. O' Donnell *et al*. (2010: 520) state that South African HCW's are likely to be admitted to hospitals with MDR-TB or XDR-TB due to numerous outbreaks of MDR-TB and XDR-TB in various communities. HCW's are five to six times more likely to be admitted into hospital with drug-resistant TB rather than a non-HCW (O' Donnell *et al*. 2010: 520).

Wood *et al*. (2011: 111) states that South Africa displays the highest per capita annual risk of TB disease when compared globally, to countries of similar size. This suggests that South African communities have extremely high TB transmission rates. Casas *et al*. (2011: 541) indicate that place of residence and socioeconomic level are both risk factors. In a study conducted by Wood *et al.* (2010: 407) the prevalence of LTBI in township populations of Cape Town indicated that an extremely high rate of LTBI was noted in childhood and adolescence in poor African townships. This study suggested that the high prevalence of LTBI in adolescence before being HIV infected may be the key factor to the extreme epidemic of HIV-associated TB. Re-activation of TB once the individual is immune-compromised is a likely possibility. This study also indicated that LTBI was present in approximately 75 percent of these township

communities at the age of 25. Wood *et al.* (2011: 113) state that the need to reduce the high rates of TB infection in high-density townships should be the main aim of long-term TB control. High risk communities should be the target, with interventions implemented in order to reduce transmission in different age groups. The age-specific interventions should be identifiable for infants, school children, adolescents and adults (both HIV positive and negative) (Wood *et al.* 2011: 114).

Studies by He *et al*. (2005: 3)**;** Mathew *et al*. (2013: 72); and Demkow*et al*. (2008: 213) indicate that increasing age is a putative risk factor for LTBI. Casas *et al* (2011: 541) indicated that the in terms of gender, males were at a higher risk of LTBI. Rafiza, Rampal and Tahir (2011: 3) also found that LTBI was more common in males in their study.

The extent of demographic factors associated with LTBI is noted in the studies referenced above. The need to also consider living conditions, family history, social and medical history of HCW's, as non-occupational exposure to *MTB* is an important factor for this study due to the high prevalence of TB disease in South Africa.

2.6. *Mycobacterium Tuberculosis*

According to the CDC (2010: 5), *MTB* infection results in two conditions, LTBI and TB disease. Drobniewski *et al.* (2007: 274) state that LTBI is "considered the persistence and multiplication of viable *MTB* bacilli within macrophages but without clinical manifestation of disease." According to Senekal (2007: 1), the CDC indicates that active TB disease must be ruled out for the definitive diagnosis of LTBI to be made. This should be done by a medical evaluation (including a history of suggestive signs and symptom), a chest x-ray and an examination of sputum or other samples of *MTB,* when indicated.

2.6.1 Diagnosis of Latent Tuberculosis Infection

Historically, LTBI has been diagnosed by the tuberculin skin test (TST) for over a century (Mahomed *et al.* 2011: 1). TST's measures the hypersensitivity response to purified protein derivative, which contains a mixture of antigens found in *MTB*. Purified Protein Derivative is a Food and Drug Administration (FDA) approved product. It is commercially known as Tubersol (Food and Drug Administration 2006: 1). According to Mahomed*et al.* (2011: 1), the subsequent introduction of IGRA's has enhanced the diagnostic methods for the detection of LTBI. However, this testing method requires a blood draw and sophisticated laboratory facilities. With economic restraints in South Africa, the lack of availability and the high costs of testing and analyzing these samples, this method still poses a challenge for LTBI diagnosis. In the eThekwini Health District, laboratory facilities at public hospitals are run by the National Health Laboratory Services (NHLS). These laboratories are not equipped with facilities to analyze samples for LTBI by IGRA (National Health Laboratory Service: *TAD Laboratory User Handbook* 2012). Diagnosis of LTBI is performed by private laboratories. In public hospitals, diagnosis of LTBI, if required, is made by the TST. This study utilized the TST method to diagnose LTBI in radiology staff. Both the accessibility and inexpensive costs of the TST influenced the researcher to use this method of testing.

The TST is however, undermined by its reactivity to the Bacille Chalmette - Guérin (BCG) vaccination and non-tuberculous mycobacterium. In South Africa, The BCG vaccination is a part of the South African national policy, requiring intradermal administration at birth. Prior to 2000, the Tokyo 1572 strain was administered percutaneously, leaving obvious BCG scars. According to the CDC (2010: 12), a history of BCG vaccine is not a contraindication for tuberculin skin testing or treatment for LTBI in persons with positive TST results. Tan and Kamarulzaman (2006: 2) state that HCW's have an increased risk of acquiring TB despite having the BCG vaccine. TST reactions should be interpreted regardless of BCG vaccination history. He *et al.* (2010: 3), also state that in

China, a country similar to South Africa, a booster BCG vaccination is not recommended. Without a booster BCG vaccination performed on the HCW's in this study, the influence of the BCG vaccine on the TST result was expected to be minimal as stated by He *et al.* (2010: 3).

Despite concerns over the TST sensitivity and specificity, it is still the more widely used immunological test for the estimations of prevalence, incidence and trends of *MTB* infection in populations. The CDC (2010: 13) suggests that HCW's (radiology staff in this study) should undergo an initial two-step TST in order to circumvent the booster effect and the misinterpretation of results as a skin test conversion. This testing method prevents false negative readings which may result due to recent TB infection, immunocompromised subjects, very old TB infection, vaccination with live viruses and active TB disease. The CDC (2010: 13) recommends that staff with a positive baseline reading should be considered as infected with LTBI. Negative baseline readings require the administration of a second TST, one to three weeks later (CDC 2010: 13). This study has utilized the two step TST method of testing.

In a study performed in South Africa by van Rie*et al*. (2013: 855) the acceptability of a free annual occupational screening programme was high. Ninety percent of medical students and eighty-eight percent of HCW's have indicated that they would participate in a potential TST screening programme. The response to a potential free IGRA screening program was higher by six percent in medical students and four percent in nursing staff.The acceptance of annual screening by South African HCW's influences this study to recommend annual medical screening for all HCW's.

2.6.2 Treatment of Latent Tuberculosis Infection

Lawn and Zumla (2011: 378) state that 1.7 million people die each year from TB, despite anti-tuberculosis drugs being discovered more than sixty years ago. According to the CDC (2006: 1) and the WHO (2013: 93) the treatment of LTBI

should not begin unless active TB disease has been effectively ruled out and the diagnosis of LTBI has been reliably established. LTBI treatment is practiced using either one of two regimens that are recommended. These include the use of isoniazid (INH) 300mg for six months on a daily basis or isoniazid 300mg with rifmpacin 600mg for three months, with the former regimen more commonly used (Menzies, Jahdali and Otaibi 2011: 257). This regimen is commonly known as Isoniazid Preventive Therapy (IPT). Menzies *et al.* (2008: 689) state that the efficacy of IPT, if completed, is 90 percent.

The WHO (2013: 93) indicates that IPT is the foundation of current recommendations made in terms of LTBI. According to Dobler and Marks (2012: 1), the treatment of LTBI is the main priority in areas where TB infection is not widespread. Treatment for LTBI is ideally used in low-incidence and high resource settings. In South Africa, the high burden of disease does not allow for LTB treatment to be a priority due to continued exposure to TB. This is not an uncommon practice as studies from Russia (Drobniewski*et al.* 2007: 278) and India (Mathew *et al.* 2013: 68), two of the 22 HBC's, state that the high prevalence of LTBI and the presence of drug resistant strains have resulted in controversial debates about the treatment of LTBI in high burden settings.

In 1998, the WHO (2013: 93) and United Nations Programme on HIV/AIDS (UNAIDS) recommended LTBI treatment for HIV positive people who do not have active TB disease and present with positive TST's (indicating TB). The second priority group is children under the age of 5 years old who are household contacts or close contacts to a TB infected individual (WHO 2013: 93). In South Africa, efforts to enforce IPT in HIV positive individuals without active TB disease have been noted. According to the Department of Health Annual Report (2012b: 56), the number of HIV patients provided with IPT was 360 168 (patients who started taking treatment in the financial year of 2011/2012). The target was set at a very low 60 000, therefore a high achievement rate was noted (Department of Health 2012b: 56). In 2013, the

WHO reported that IPT was initiated in 520 000 HIV positive individuals, globally. South Africa accounted for 71 percent of the global total with 370 000 people reported to have been provided with IPT in 2012 (WHO 2013: 74).

In high incidence settings such as South Africa, the long lasting effects of IPT have been questioned. Whitaker *et al.* (2013: 7) state that in resource limited settings where TB disease is endemic, the focus of resource allocation should be on the diagnosis and control of active TB disease. Gershon*et al.* (2004: 667) and Dobler and Marks (2012: 1) indicate the benefits of IPT, however only in low-incidence, high resource areas. These benefits may not be as relevant in South Africa, due to the overall high burden of disease. INH is an important TB treatment drug; however TB strains are gradually showing some level of resistance. According to Lin and Flynn (2010: 17) historically, the spectrum of TB disease has been limited to active disease and LTBI. With active TB disease manifesting in various strains and displaying antimicrobial resistance, the likelihood of LTBI having a spectrum is possible. Factors such as time, frequency of exposure, strain, inoculums, severity of disease and presence of co-infections or other medical complications can all affect the outcome of treatment.

According to Meldrum (2014: 1) the effectiveness of INH as therapy depends highly on the quality of the TB diagnosis and the success of TB treatment in the community. If treatment in the community is poor, then use of INH will remain problematic. The issue of protecting the most vulnerable population at risk of developing active TB can only become a priority once the overall TB prevalence is reduced (Meldrum 2014: 1) Ongoing treatment for high risk groups, including HCW’s and close contacts with active TB can be considered and frequent evaluations of patients on treatment should be performed, in order to determine the development of active TB disease.

2.7. Conclusion

South Africa, ranks third amongst the top 22 high burden countries of TB. Health systems and NTP's have performed poorly over the past 2 decades, due to a failure to recruit and train a sufficient number of HCW's; and to regulate drug suppliers and pharmacies. A failure to provide treatment for drug-susceptible disease has also been noted. As a result, cure rates have fallen short of the recommended 85 percent benchmark. This fact, increases the risk of TB transmission to HCW's, including radiology staff.

At the outset HCW's are already considered a vulnerable group for TB infection. Direct contact with patients and exposure to active TB cases in the community make TB a dual threat to HCW's. Should HCW's develop active TB disease, they are at risk of transmitting the infection to their patients, including those who are immunosuppressed. A lack of adequate infection control measures and compromised working environments increases the risk of transmission of *MTB*. Occupational exposure, with regard to exposure to infectious patients and different categories of staff, play an important role in LTBI. Demographics and socio-economic factors also contribute to the risk of LTBI. It was necessary to determine the association of these factors with LTBI in radiology staff in order to describe the various levels of risks associated with each category of staff.

The need for the identification and monitoring of LTBI is essential in order to prevent or delay the progression of the infection to active TB disease. Surveillance for active TB disease and LTBI among staff may provide data useful for TB control practices for HCW's and in particular those who are at high risk of infection, such as radiology staff. With the aim of this study being an investigation into the association of occupational and demographics with LTBI in radiology staff, it is hoped that recommendations made will contribute to the improvement and research of occupationally acquired TB within the field of radiology.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Research entails plans and procedures that determine a spectrum of decisions, ranging from broad assumptions to detailed methods of data collection and analysis. It involves a combination of philosophical assumptions, designs and specific methods (Creswell 2014: 247).

This section outlines the methodology used to conduct this study. It discusses the study design, the location, the study population and sample size, the inclusion and exclusion criteria used, the data collection process including the pilot study and the data tools implemented, the verification of the data obtained, the reliability and validity within the study, the ethical approvals obtained and other ethical considerations made; and any problems encountered by the researcher.

3.2 Study Design

According to Creswell (2014: 247), quantitative research allows for the testing of objective theories by examining the relationship among variables. It allows for the variables to be measured so that numerical data can be analyzed using statistical procedures. This study was conducted using quantitative methodology and a cross-sectional design to undertake a descriptive analysis of the association of demographics and occupational factors with LTBI in radiology staff in public sector hospitals of the eThekwini Health district. According to Saks and Allsop (2013: 33), cross-sectional designs refer to studies that require the collection of data from a number of subjects/objects over a specified time, with the aim of establishing an association between variables. The aim of using this method in a study is to find variations using the same tool to measure

differences. Inferences can be drawn from determining the associations between variables. The aim is to select particular criteria to establish similarity and differences across the units being analysed to make generalizations. A descriptive survey method incorporating logistic and deductive reasoning was used to evaluate the objectives of the study.

The study was granted full ethical approval on 20 November 2012 by the Institutional Research Ethics Committee (IREC) of the Durban University of Technology (DUT). The ethical clearance number provided was IREC 047/12 (Annexure A). Permission to conduct the study was also obtained from the KZN Department of Health (Annexure Bi) and the eThekwini Health District (Annexure Bii) as well as the individual hospitals used.

3.3 Study location

The study was set in the eThekwini Health District, situated on the eastern seaboard of Kwa-Zulu Natal, South Africa. With a population of 19.7 percent of the countries inhabitants (Statistics South Africa 2013: 3) and the highest incidence of TB cases in the country (Department of Health 2011b: 1), KZN's eThekwini district provided an adequate study location. Radiology departments of eight public hospitals (both regional and district levels) were included in the study.

3.3.1 Health-care facilities

Tertiary and specialist hospitals were not included due to limited access in terms of conducting research at tertiary hospitals and logistical reasons when considering the specialist hospitals in the eThekwini Health district. Tertiary hospitals are level three facilities providing specialist and sub-specialist care. Specialist hospitals focus on a specific specialty, the most common being psychiatry and chronic diseases such as TB (Cullinan 2006: 19). Psychiatric facilities do not have radiology departments and the inclusion of a designated

TB hospital into this study would have skewed the findings of the study, therefore these facilities were excluded.

Table 3 below indicates the hospitals that were included in the study, their institutional level and the approximate number of radiology staff at each institution.

Table 3: Hospitals and Radiology Staff:

Institution	Level	Radiology Staff
Addington Hospital	Regional (2)	54
Clairwood Hospital	District (1)	6
King Edward VIII Hospital	Regional (2)	71
Mahatma Gandhi Memorial Hospital	Regional (2)	23
Osindisweni Hospital	District (1)	7
Prince Mshiyeni Memorial Hospital	Regional (2)	53
R.K. Khan Hospital	Regional (2)	49
Wentworth Hospital	District (1)	14
Total Staff		279

The eThekwini Health District consist of various clinics, community health centres, district hospitals (level 3), regional hospitals (level 2) and one tertiary hospital. The National Health Act 2003 (South Africa 2012: 4), updated in March 2012, defined district hospitals (level 3) as institutions that serve a defined population within a health district. They support primary health care services and receive support from general specialists based at regional hospitals. Regional hospitals (level 2) are defined as institutions that provide health services to a defined regional drainage population; they are limited to provincial boundaries and they receive referrals from district hospitals. These facilities provide care requiring the intervention of specialists, general practitioners and intensive care (South Africa 2012: 4). Regional hospitals are often the most

overburdened of all the levels of hospitals due to the referral system (Cullinan 2006: 16).

3.4 Study Population

The study population included all staff permanently employed in the radiology department. The total population for this study, according to one telephonic conversation (with the Radiography manager) and lists provided by the seven other institutions was approximately 280 staff. Changes in staff establishments at the various facilities due to entrance and exit of new and old staff, respectively, over the study period was a limitation in terms of obtaining accurate numbers of staff at the proposal phase. The researcher over-estimated the number of radiology staff (340 as the estimation); therefore a higher sample size was predicted. Changes to the study were not made after exact numbers were determined. This was due to the researcher obtaining the recommended sample size. The population included in this study consisted of diagnostic radiographers (including the community service radiographers), radiology doctors, administrative staff, darkroom technicians, cleaners, general assistants, porters and radiology nurses. Upon the commencement of data collection, radiology doctors were excluded from the study due to their overall lack of participation.

3.5 Study sample size

At the proposal phase of the study, the minimum statistically acceptable sample size for a population of 340 participants was 181 participants for phase one of the study. Due to ethical limitations at the proposal stage, exact staff establishments could not be obtained from radiography managers; therefore an estimated population size was used in order to determine the acceptable sample size. The sample size was determined to be adequate in consultation with a professional statistician prior to commencement of the study. This was calculated to ensure a 95 percent confidence interval. Due to the study having

specific exclusion criteria for phase two, based on the responses from phase one, a sample size for the second phase could not be predicted. A total of 182 participants were noted for phase one of the study.

3.6. Inclusion and exclusion criteria

According to Kothari (2004: 18) inclusion and exclusion criteria are used to define the study population. The process of defining the target population through specific characteristics determines the kinds of people best suited to the research question. The importance of specific inclusion and exclusion criteria allow for the results of the study to be generalized within the target population (Kothari 2004: 18).

The study consisted of two phases. Each phase required participants to complete informed consent documents (Annexure Ci-English and Cii-isiZulu for Phase one and Annexure Ciii-English and Civ-isiZulu for Phase two). Phase one of the study required the completion of a questionnaire (Annexure Di-English and Dii- isiZulu) and phase two of the study was the administration of a two-step TST, to all eligible participants. This study excluded participants as the study progressed. Due to this, there were two sets of inclusion/exclusion criteria, designed specifically for each phase. The exclusion of participants from phase two was done after submission of the questionnaires. The criteria listed below were used in this study.

3.6.1 Inclusion criteria (Phase one)

- Persons employed in the radiology department,
- 18 years or older; and
- Persons that completed an informed consent for the questionnaire in order to allow the researcher to use the personal information obtained from the questionnaire.

3.6.2 Exclusion criteria (Phase one)

- Those who do not meet the inclusion criteria above.
- Any staff member who declined to accept a questionnaire.

3.6.3 Inclusion Criteria (Phase two)

- All participants that signed an informed consent, thus indicating willingness to participate.
- Those who completed the questionnaire in phase one and were not excluded based on the criteria listed below for phase two (These exclusions were determined based on the responses to the questionnaire in Phase one).

3.6.4 Exclusion Criteria (Phase two)

Any person that:

- was immunocompromised at the time of the study. This may be due to viral infections including HIV, leukemia, sarcoidosis, use of glucocorticosteroids and other immunosuppressant agents, bacterial infections, fungal infections, metabolic derangements, low protein states and diseases affecting lymphoid organs.
- had an allergic reaction to a TST previously.
- had extensive burns or eczema as this is a contraindication to the TST.
- had been vaccinated in the past month with live viral cultures, example mumps or measles (Vaccination for the common cold was not an exclusion factor).

Figure 2 illustrates the inclusion and exclusion processes of the study:

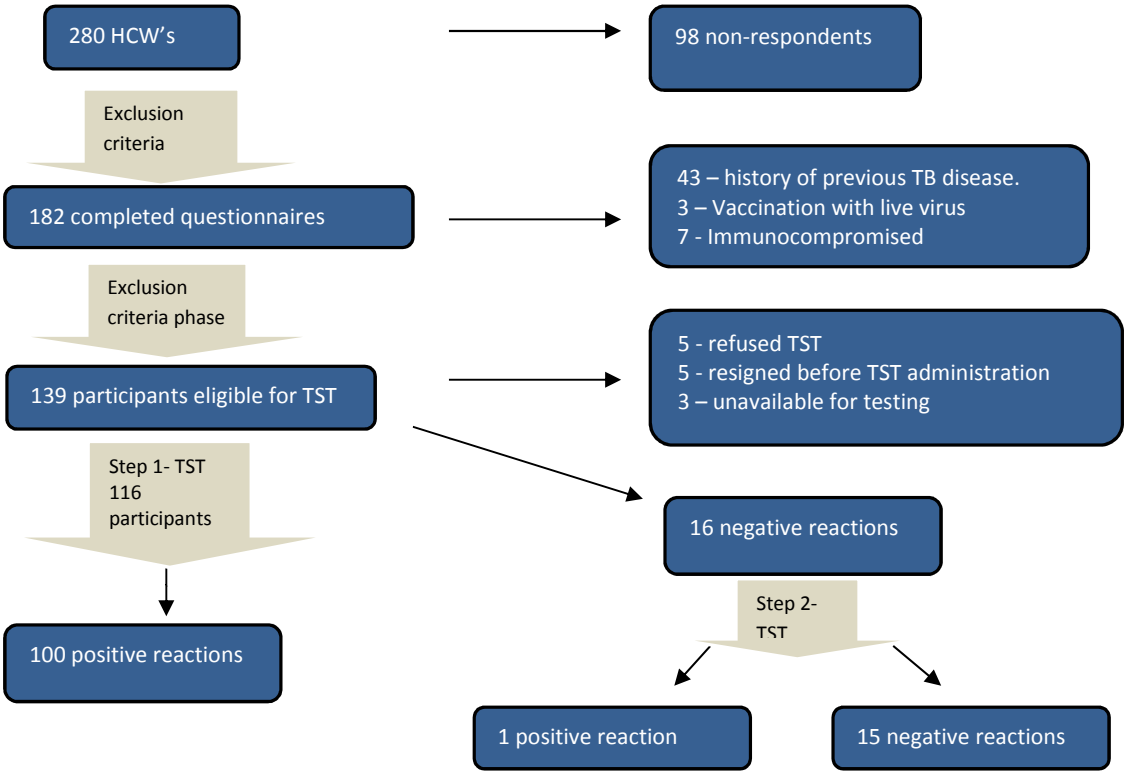

Figure 2: Data Collection Process

3.7 Types of Data

Primary data for this study was obtained from a questionnaire and a TST that was administered to participants that were eligible to be tested. According to Creswell (2008: 92) primary data includes information reported by an individual that has conducted the research by him/herself. Secondary data included literature from peer-reviewed journal articles, government publications and books.

3.8 Data collection process

Permission was sought from the eThekwini Health District and the Kwa-Zulu Natal Department of Health, after ethical clearance was obtained from the IREC of DUT. Further permission was sought from individual institutions and Heads of Radiography Departments were notified of the researcher's intent to conduct studies in their departments.

a) Phase one

Phase one of the study aimed to define the target population with the aid of a questionnaire. The researcher visited all selected hospitals and presented the study to all available radiology staff (either individually or at a staff meeting), prior to requesting participation. An isiZulu questionnaire was also formulated in order to accommodate support staff working in the radiology department, who were only conversant in isiZulu. This questionnaire was back-translated from isiZulu to English in order to ensure that the integrity of the questionnaire and the meaning of each question were retained. Staff requiring further isiZulu translations were assisted by colleagues within their departments in order to ensure full understanding of the research and its requirements.

The questionnaire and two-step TST was administered during hours that did not affect the normal work processes of the radiology departments. On average, each phase took approximately five minutes and three minutes, respectively. This time frame included the completion of informed consent, available in both English and isiZulu, for each phase. Subjects were asked to participate when allowed time by Heads of Department, during their tea/lunch breaks or after hours. The researcher liaised with the Heads of Departments to determine suitable times to conduct the study, so as not to compromise service delivery and patient care. Participants were made aware that they could be excluded from the study during the process of completing the questionnaire and they could also be excluded prior to having the TST done. The exclusion criteria for phase 2 were not discussed by the researcher as they related to sensitive health statuses.

A self-administered questionnaire was handed out by the researcher to all radiology staff that were willing to participate. Due to the sensitivity of the questions, staff were invited to accept questionnaires. No staff member was forced or coerced into accepting a questionnaire if they were unwilling. It was proposed that all radiology staff were to be provided with questionnaires and

returning an incomplete questionnaire would indicate their unwillingness to participate. In so doing, staff would not feel discriminated against as everyone would have returned a questionnaire regardless of whether it was completed or not. At the outset, however, all non-participants refused to accept questionnaires. This was due to most participants indicating a lack of interest and others indicating that they did not want to disclose any information, in terms of the research questionnaire. This included the category of radiology doctors (consultants and registrars). Various failed attempts to enlist participation from radiology doctors resulted in the exclusion of this category of staff from the study. The total sample for the study was the 182 radiology staff that completed the questionnaires for phase one.

The researcher co-ordinated the survey ensuring confidentiality, as each questionnaire required personal & sensitive information. Identifiable information (names, dates of birth and identification numbers) was not included in the questionnaire. Separate informed consent for each phase of the study was obtained from all participants at the relevant phases in order to comply with ethical requirements. These consent forms were available in both English and isiZulu. Each questionnaire was coded and included a separate information and consent form, requiring identifiable information. This was attached as a cover page to the questionnaire in order for the researcher to keep a record of consent forms and questionnaires distributed, ensuring that consent forms and questionnaires correlate with the number coding system that was used to maintain confidentiality. Only the researcher was and is permitted to link the codes to the names. Participants were made aware of the coding system on the questionnaire, in order to reassure them that the information they provided would remain confidential at all times.

Participants were asked to complete questionnaires in a private room, provided by the Managers of Departments, within the radiology department. No other persons were permitted into the room whilst occupied by the participant in order

to prevent external influence or bias to the answers they provided. This also ensured confidentiality and maintained the privacy rights of all the participants. All participants requested that the researcher remain in the room in order to assist with any queries. Participants were asked to place questionnaires, either complete or partially complete, into a secure box. The box was only accessible to the researcher, ensuring strict confidentiality of the contents of the questionnaire.

In some cases participants found that if they answered “yes” to any of the first questions specifically relating to active TB disease, they were excluded immediately. With this study describing associations to LTBI, it was decided at the proposal stage to eliminate these participants since active TB disease is a contraindication to the TST. This also ensured that participants who previously or currently have active TB disease were excluded prior to disclosing any information relating to their personal, medical, occupational and demographic details, as this was not used in the study. Privacy, dignity and confidentiality of this information were maintained and these participants were automatically excluded from participating in phase two. This was the end of phase one.

b) Phase two

After submission of the completed questionnaires, the researcher selected participants for phase two of the study, according to the phase two inclusion and exclusion criteria. Participants excluded from phase one of the study made up 29.12 percent (53 participants) of the study population; forty-three participants (23.62 percent) with a history of active TB disease were eliminated from the study. Limited data collected from these participants allowed only for the prevalence of active TB disease amongst the radiology staff to be determined. The other ten participants were excluded due to seven (3.84 percent) being immunocompromised [two were positive for the HIV (1.09 percent), two were pregnant (1.09 percent) and three (1.64 percent) suffered

from other illnesses, including cancer] and; three (1.64 percent) due to having recent vaccinations with live viruses, including Hepatitis B and H1N1.

Due to a three month delay in accessing the correct, suitably trained medical professional; to administer the TST, fiveparticipants who had been vaccinated previously (indicating in the time of administration in their questionnaires) were able to be included into the study. The dates of vaccination became obsolete due to the delay in TST administration. A data collection sheet (Annexure E) for each participant's TST administration and interpretation was used to record relevant information.

Participants were informed that exclusion from phase two was based solely on the outcomes of their questionnaires. Participants that did not qualify for phase two of the study were excluded based on their responses to specific questions relating to TST contraindications (Annexure F). This ensured that those participants would not suffer any possible adverse reactions to the TST. The researcher personally informed participants whether or not they would proceed to phase two. The second phase exclusions were made when some participants refused the TST (2.74 percent), resigned from the Department of Health before the test was performed (2.74 percent) or were unavailable for testing (1.64 percent). The total number of participants that had the TST done was 116 individuals. All eligible participants were identified and invited to complete the second information and consent form, designed for phase two. This was done to ensure that each participant understood the TST process and what was required of him/her.

Eligible participants then proceeded to have a two-step TST performed in order to determine the presence of LTBI. The TST was administered by an experienced, registered medical professional who accompanied the researcher to the healthcare facilities. The TST was conducted in the privacy of a secure, clean, isolated room, ensuring a high standard of patient care and infection

control. All aseptic and infection control measures were applied and maintained. Interpretation of the results were performed by the same trained medical professional 48 -72 hours later at each participant's place of work. It is recommended by the CDC that staff with positive baseline readings be considered as infected with LTBI. Negative baseline readings required the administration of a second TST, one to three weeks later (CDC 2010: 13).

Step one of the TST was performed on 116 participants. The Mantoux Method, requiring intradermal injection of 0.1mls of 5TU of Purified Protein Derivative (PPD) into the volar aspect of the forearm was used. The area was cleansed with an alcohol swab, allowed to dry and administration of the antigen followed. To maintain patient ethics and rights, the syringes and needles were opened in full view of participants. Participants were advised not to dress, scratch, rub or bathe the area until the reading was done, 48 -72 hours after administration. Participants were required to inform the researcher of any allergic reaction or discomfort. Administration and interpretation of the TST was documented on individual data sheets for each participant.

To maintain a standard, step one of the TST was administered on the left forearm of participants, unless contraindicated. Areas with prominent veins, excess hair, tattoos, burns, scars and rashes were avoided. Five participants had their TST's administered on the right forearm due to either a rash, scarring or previous burns. None of these participants went on to have a second TST administered, as they had positive reactions after the first TST. One hundred participants displayed positive reactions (TST indurations of >10mm). A positive TST response for HCW's is defined in Annexure G. The second TST was administered on the right forearm as a standard. Between two to three weeks after the first TST, sixteen participants went on to have the second step of the TST. Only one participant converted from a negative to a positive reaction. The remaining fifteen participants had no reaction.

Participants were informed of their TST results. Recommendations to seek further diagnosis, by use of IGRA tests, and treatment at Occupational Health Clinics were made. Copies of the TST results were made available to participants, if required. The course of treatment for the presence of LTBI was to be decided by the participants. IGRA testing was to be self-funded by the participants as it is expensive and not available in government hospitals. No adverse events were noted in this study.

3.8.1 Data collection tools

According to Saks and Allsop (2013: 23) the use of instruments in research allows for the acquisition of reliable quantitative data. The measuring tool or instrument allows for observation, measurement or documentation of the data. Creswell (2008: 161) states that measuring tools or instruments include tests, questionnaires, tally sheets, assessment instruments, inventories or observational checklists. In this study, the data collection tools used are a questionnaire and a TST data collection sheet.

a) Questionnaire

Questionnaires from phase one were made available in English and isiZulu as required by the DUT IREC. The questionnaire consisted of closed questions that were clear, succinct and unambiguous so that subjects clearly understood the questions. The questions were short, with simple vocabulary. There were no leading questions and the subjects were required to tick one box only. For questions where there were options or where more than one answer was necessary, this was clearly indicated in the question and the participant was asked to tick the necessary box or boxes. Questionnaires were coded with a number that corresponded with each participant, to ensure anonymity. This allowed the researcher to link participants to their questionnaires, without names having to be provided. Access to the number coding sheets corresponding to the questionnaires was restricted to the researcher only.

Data obtained from the fully completed questionnaires included demographic factors, occupational, medical and social history of all subjects. This data was used to determine the association of demographic and occupational factors with LTBI. The research instrument consisted of 81 items, with a level of measurement at a nominal or scale level. The questionnaire was divided into 5 sections which measured various factors as illustrated in figures 3, 4, 5, 6 and 7 below.

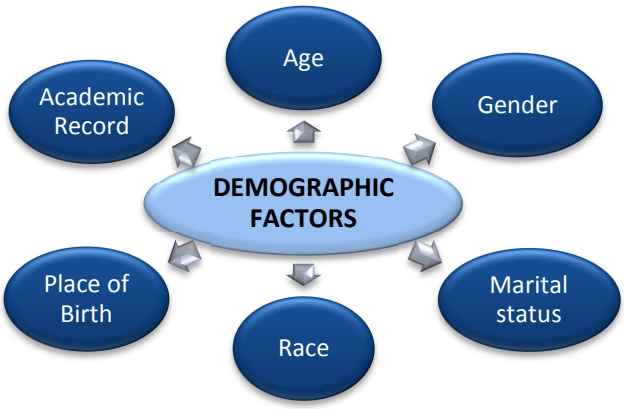

Figure 3: Section A – Demographic Details

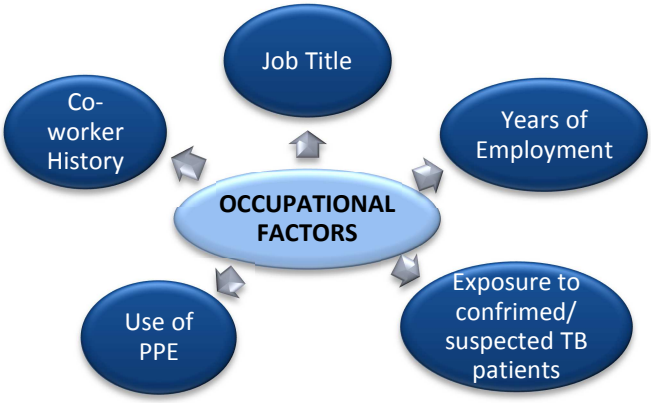

Figure 4: Section B – Employment Details and History

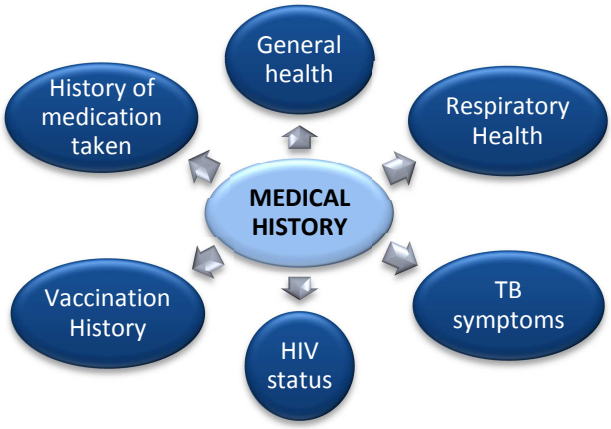

Figure 5: Section C – Medical Details

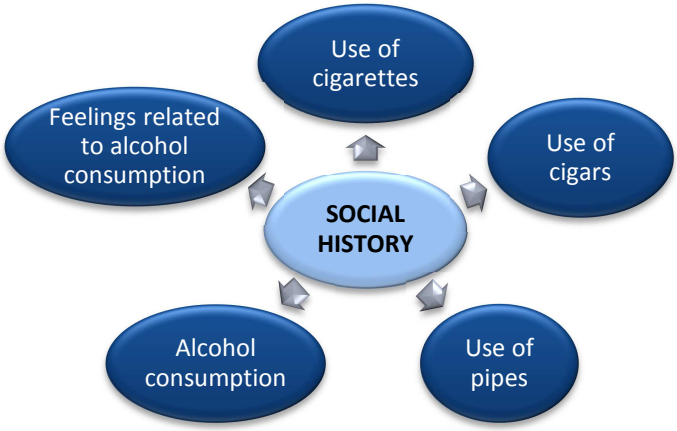

Figure 6: Section D – Social History

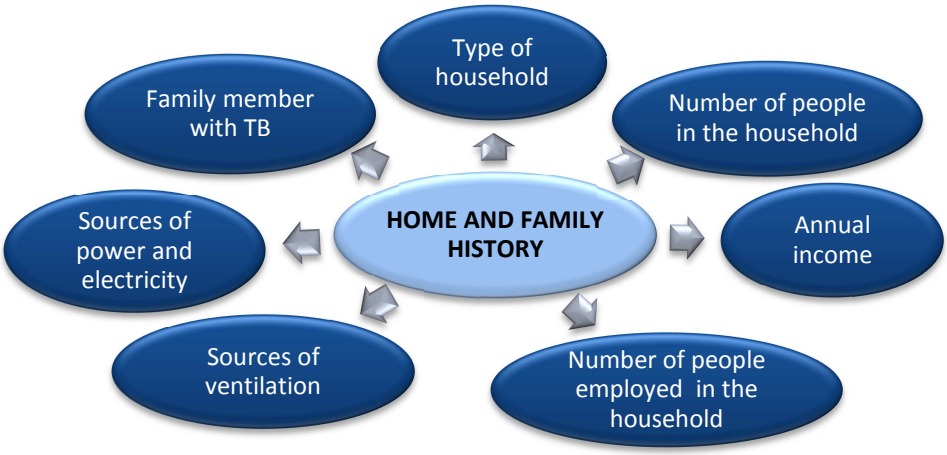

Figure 7: Section E – Home and Family History

b) Tuberculin Skin Test

The TST, also known as the Mantoux skin test is used to determine the presence of *Mycobacterium Tuberculosis* infection in humans. According to the CDC (2010: 26), the TST is administered using the Mantoux Method of TB diagnosis, requiring the intradermal injection of 0.1mls of 5TU of Purified Protein Derivative (PPD) into the volar aspect of the forearm. This method of administering the TST was used in this study. Tuberculin (Purified Protein Derivative) is an FDA approved drug that has been used in TST's for over a century. This advocates the safety of this testing method.

The test was performed using aseptic techniques and complied with infection control measures. No adverse reactions were noted and the test was only used for purposes of the study, allowing associations of demographic and occupational factors with LTBI to be determines.

3.9 The Pilot Study

According to Thabane*et al*. (2010: 1), a pilot study is defined as an "experimental, exploratory, test, preliminary, trial or try out investigation" as per the Concise Oxford Thesaurus. The questionnaire used in this study was piloted using radiology staff in a non-participating (King Dinuzulu Hospital) hospital in the eThekwini district. The English and isiZulu questionnaires were piloted on a sample comprising of all levels of workers found in the radiology department at the King Dinuzulu Hospital. English and isiZulu versions of the questionnaire were provided to different categories of staff, depending on their first languages and levels of understanding. A total of eight staff were included in the pilot study. This number is relevant to the total number of staff (24) at King DinuZulu Hospital, according to the Head of Radiography: Mrs Maishi (2013, pers. comm. 03 February). Creswell (2014: 161) states that pilot testing determines the validity of the scores on an instrument. It allows for the improvement of content in terms of questions, formats or scales. Feedback was requested from the staff

after they read the questionnaire. Feedback from the staff at King Dinuzulu Hospital radiology staff indicated that the questionnaires were clear and all questions were easily understood. No corrections were made after piloting the questionnaire. Due to this questionnaire being adapted from a previous study, corrections were not anticipated.

3.10 Reliability

According to Creswell (2008: 646) reliability refers to the reproducibility of the results obtained from an instrument without measurement error. The questionnaire (modified for this study) was obtained from the Department of Occupational and Environmental Health at the Nelson R. Mandela School of Medicine, University of Kwa-Zulu Natal. It was previously used in a similar study on a different group of HCWs by Dr. S. Naidoo, the co-supervisor of this study (Naidoo 2012). Her permission was obtained to use this data tool. The use of this tool in a previous study adds reliability to the questionnaire design and validity of results. The questionnaire was modified and revised so as to obtain the relevant information required in order to determine associations of demographic and occupational factors to LTBI in radiology HCW's. It was designed to ensure that only eligible participants were considered for the TST, due to the various contraindications of TST administration. The pilot study conducted amongst radiology staff in a non-participating hospital, assisted in determining the straightforwardness of the questionnaire

The TST, which is Food and Drug Administration (FDA) approved, is a test that has been used for the diagnosis of LTBI for over a century. The TST was performed by a trained medical professional, who accompanied the researcher to all venues. Interpretation of the TST was performed by the same medical professional at all venues, approximately 48 -72 hours after each administration. This ensured reliability of the TST administration and results. The second TST administration was also performed in this manner by the same person and the researcher was present at all times.

3.11 Validity

According to Kothari (2004: 73) validity refers to the accuracy of an instrument in terms of what it is required to measure. Content validity of the questionnaire was adequately maintained by ensuring that the content of the tool covered the topic in this study and that a pilot study was performed (Kothari 2004: 74). Due to the researcher being present when participants completed the questionnaires and during the administration of the TST's, validity was maintained by ensuring that participants understood the questions adequately in order to provide honest answers. No participants were excluded from the study due to incompletion of relevant information or not providing the researcher with consent. Where necessary, corrections were effected immediately to ensure validity of data for reliable statistical analysis. TST interpretations were made by the trained medical professional and recorded by the researcher to facilitate the study. These records were verified by the medical professional in order to ensure that the data recorded was accurate

3.12 Verification of the data input

The verification and accuracy of the data input was cross-checked by the statistician to ensure that all data input was correct. Numerical data was captured by the researcher onto an Excel spreadsheet in accordance with instructions from the statistician who double checked it to ensure accuracy.

3.13 Statistical Analysis

The services of a professional statistician were used to analyze raw quantitative data. The data collected was analysed with SPSS version 17.0. The statistical aspect of the research included the following:

- descriptive statistics,
- inferential statistics and
- the chi-square test.

Descriptive Statistics is used to describe the organizing and summarizing of quantitative data, investigate the distribution of scores on each variable, and determine whether the scores on different variables are related to each other (Kothari 2004: 130). The descriptive statistics of the data collected for this study are presented in the form of graphs, cross tabulations and other figures.

Inferential techniques include the use of correlations and chi square test values; which are interpreted using the *p*-values (Kothari 2004: 13). Frequencies and means were used to describe categorical and continuous variables respectively. The inferential statistics of this study are presented in tables.

The t-test and chi square were used to test for significant associations between continuous and categorical variables and the dependent variable under study on bivariate analysis. Binary logistic regression analysis was used to test for associations between independent variables and the dependent variable under study on multivariate linear regression analysis. The use of the multivariate regression analysis allows for predictions to be made about the dependent variable based on its covariance with the independent variables included in the analysis (Kothari 2004: 315). Independent variables entered onto the regression model included: demographic (age and gender), occupational (job title, use of PPE, average time spent with a TB case, duration employed in KZN DoH and the number of co-workers diagnosed with TB), medical (general health), socio-economic (annual income, use of alcohol and cigarettes) and household (number of people in your home and family members diagnosed with TB) risk factors. The dependent variable was the size of the first induration. The level of significance was set at 0.05 (α=0.05). The use of accepted significance levels (0.05 or 0.01) allows for the researcher to make deductions in terms of accepting or rejecting the null hypothesis in relation to the variables of this study

3.14 Ethical Approval and Considerations

The study was granted full ethical approval on 20 November 2012 by the IREC of the DUT. The ethical clearance number provided was IREC 047/12. Permission to conduct the study was also obtained from the KZN Department of Health and the eThekwini Health District. The relevant hospitals and radiography managers were informed of the approval prior to commencement of the study.

The study was conducted in accordance with the ethical guidelines provided by the DUT for conducting research in the Faculty of Health Sciences. Providing participants with information and consent letters, either in English and isiZulu, allowed them to fully understand the nature of the study, including the possible risks and benefits. Consent, according to the European Commission (2010: 198), is to allow permission. Valid consent is obtained by ensuring three conditions are maintained. These include participants that are competent, adequate information is provided and time is allowed for the participant to make a reasoned decision about participation and allow understanding of the study; and consent is voluntary (European Commission 2010: 198). In this study, valid consent can be justified as it met the three main conditions required by the consenters. It ensured that participants understood the information, they made reasoned decisions, were capable of communicating their consent or refusal; and they were not coerced or manipulated into consenting for this study. Participants were made aware that the study was entirely voluntary, therefore no remuneration was provided nor were any costs incurred by them.

The respect for autonomy was maintained by allowing autonomous participants to make decisions in terms of participation in this study and their decisions were acknowledged. Participants were allowed to withdraw themselves from the study at any point and were not forced to participate. Confidentiality was maintained at all times as sensitive information was provided by participants. According to the European Commission (2010: 199) confidentiality is similar to

privacy, however, it refers to the part of privacy that requires that information is not discussed or revealed without the permission of the person concerned. In this study, the identities of all participants were protected by a number coding system to ensure anonymity. The researcher documented the names of each participant alongside the number code in a separate document in order to identify participants for phase two. Only the researcher was and still is able to access this document. All data collected has been kept strictly confidential and is only being used for research purposes.

Ethical considerations such as beneficence (the obligation to provide benefits and to prevent any harm) and non-maleficence (the obligation to not inflict harm) were considered when conducting this study (European Commission 2010: 201). The benefits of this study do outweigh the risk, as participants with positive TST's were advised accordingly with regard to seeking treatment. The overall result of the study will propose improved annual medical screening. This will allow for the early diagnosis and treatment of undetected active TB disease and will assist in reducing the spread of TB amongst HCW's.

3.15 Problems encountered in data collection

According to Bocar (2013: 61) every research study may encounter unexpected problems. The research problems encountered in this study have been stated below in order to ensure transparency and honesty and thus prevent the possibility of deception.

The challenges encountered during data collection were as follows:

- Prior to commencement of the data collection, the registered professional nurse that initially agreed to assist in the study declined to facilitate the administration and interpretation of the TST due to personal reasons. The researcher was introduced to another registered professional nurse specializing in infection control in the private sector. Her knowledge and

expertise in the area of TB allowed the researcher to complete the study. The delay in resourcing a second trained professional allowed for the inclusion of some individuals that had been vaccinated in February through to March. This did not influence the overall study result.

- Radiology doctors (consultants and registrars) did not participate in the study resulting in an absence of information on this category of staff. All doctors reported that they lacked time to complete the questionnaires. The researcher made attempts for a number of days to leave questionnaires with some doctors, however they were returned incomplete. Even though this category of staff was eliminated from the study, the researcher obtained the statistically acceptable number (181) of staff to participate in this study.

- The irregularity in shifts and absence of staff due to leave made the study difficult. After numerous visits to departments, the researcher was able to meet the statistical requirements thus ensuring validity and reliability of the study.

3.16 Conclusion

The data obtained during the study was able to provide insight into the objectives of the study. Each phase of the study was designed to assist in obtaining the objectives. The occurrence of demographic or occupational associations with LTBI in radiology staff can be ascertained from the data collected. Despite limitations and problems encountered during the study, the researcher obtained valuable information for demographic and occupational factors associated with LTBI in radiology staff.

Chapter 4 presents the results of the study, using tables and figures to illustrate findings. A descriptive and inferential analysis is presented in this chapter.

CHAPTER 4

RESULTS

4.1 Introduction

This chapter provides detailed information on the findings of the research.The questionnaire, distributed to practicing radiology staff, and tuberculin skin tests were the primary tools that were used to collect data. The results of the questionnaire are presented as a sectional analysis of the tool. The data collected from the TST is presented independently, using summarised percentages. The results of the bivariate analysis and the linear regression models are presented after the descriptive statistics.

4.2 Descriptive Statistics

4.2.1 Sectional analysis of the questionnaire

The information that follows is a statistical summary of the responses and outcomes of the questionnaire administered to the radiology HCW's. Data listed below indicates results for the group tested, i.e. participants that qualified for both phases of the study. Exclusion of participants was based on the criteria outlined for the second phase of the study. As noted previously, participants with active TB disease were excluded before answering any questions relating to their demographic, employment, social, medical, and home and family history. The results below are displayed for the 116 HCW's that qualified and participated in phase 2.

Each section analyses the scoring patterns of the respondents per variable per section. The results are first presented using summarised percentages for the variables that constitute each section. Results are then further analysed according to the importance of the statement.

Section A - Demographic data

This section summarises the demographic characteristics of the respondents.

Table 4: Demographic description of the study population

Variable		N	%
Sex:			
	Male	36	31
	Female	80	69
Age*			
	20-<30 years	37	31.9
	30-<40 years	28	24.1
	40-<50 years	27	23.3
	50-<60 years	20	17.2
	60-<70 years	3	2.6
	70-<80 years	1	0.9
Country of Birth:			
	South Africa	113	97.4
	Foreign Born	3	2.6
Race:			
	African	44	37.9
	Coloured	8	6.9
	Indian	61	52.6
	White	3	2.6
Marital Status:			
	Divorced	2	1.7
	Married	53	45.7
	Single	58	50
	Widowed	3	2.6
Academic Qualification:			
	Less than a matric	10	8.6
	Matric	19	16.4
	Certificate	11	9.5
	National Diploma	55	47.4
	Undergraduate Degree	3	2.6
	Postgraduate Degree	18	15.5
Total		116	100

* Mean (*M*) age 36.0. Range 21-75 years

Table 4 describes the demographic information of the participants. Data recovered indicated that 50 percent of the participants were single, whereas 45.7 percent were married. Divorced and widowed participants made up 1.7 percent and 2.6 percent of the group, respectively. Participants born in the Republic of South Africa made up 97.4 percent of the study, with 2.6 percent of participants being of foreign decent. Indians (52.6 percent) constituted more

than half of the group tested. Africans constituted the second highest amount at 37.9 percent and Coloureds and Whites followed at 6.9 percent and 2.6 percent, respectively.

The study indicated that approximately half of the respondents (47.4 percent) had a National Diploma, with 75 percent of the study population having some level of tertiary education. Participants who had not matriculated made up 8.6 percent of the population

The gender of participants categorised by age is included in the table below.

Table 5: Sex of participants categorised by age

Category	Female N	%	Male N	%
20- <30 years	28	24.1	9	7.8
30- <40 years	20	17.2	8	6.9
40- <50 years	14	12.1	13	11.2
50- <60 years	15	12.9	5	4.3
60- <70 years	2	1.7	1	0.9
70- <80 years	1	0.9	0	0
Total: 116 (100%)	80	69.0	36	31.0

The ratio of females to males was 7:1 (69 percent: 31 percent).Within the age category of 20 to 30 years, 75.7 percent were female. Within the category of females (only), 35 percent were between the ages of 20 to 30 years. This category of females between the ages of 20 to 30 years formed 24.1 percent of the total group tested. The age categories of 60 to 70 years and 70 to 80 years displayed the lowest percentages, with 1.7 percent and 0.9 percent, respectively.

Section B – Occupational data

The tested group held the following job titles:

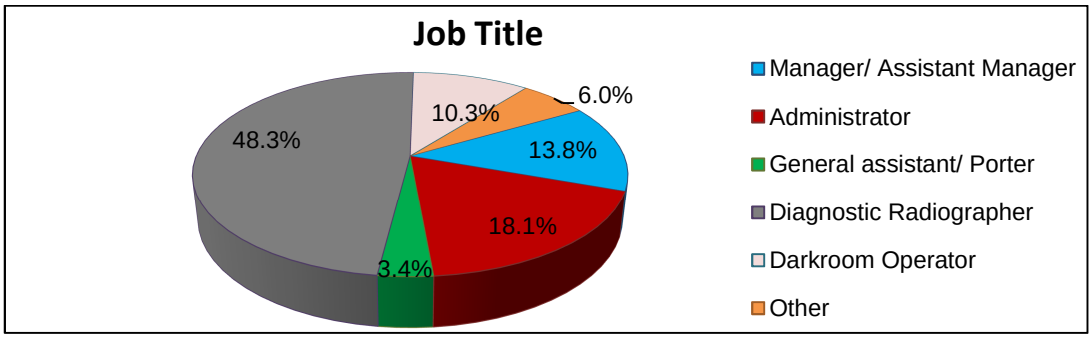

Figure 8: Occupational categories of the study population

Nearly half of the participants were diagnostic radiographers (48.3 percent). Managers and assistant managers made up 13.8 percent of the tested group. Administrative staff and darkroom operators made up 18.1 percent and 10.3 percent of the study group, respectively. These categories made up 90.5 percent of the group tested. Four of the radiology departments, included in the study, did not have nursing staff and cleaning staff as a part of their staff establishment.

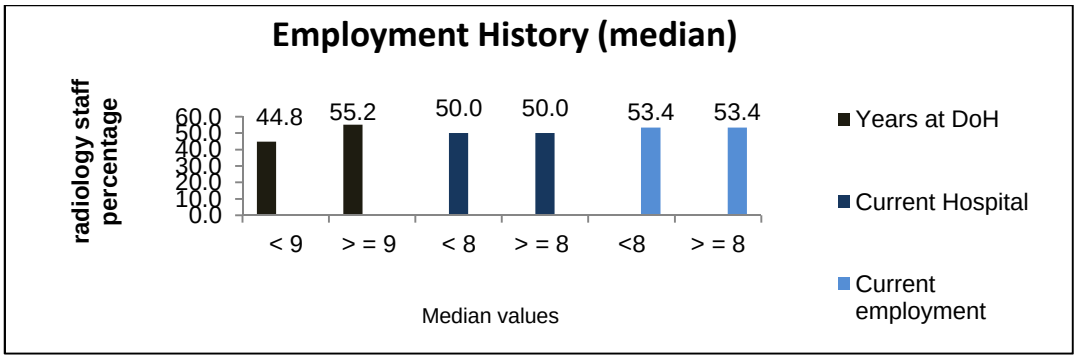

Figure 9: Employment history (median) of the study population

Figure 9 displays the median values of participants' employment history and current employment. These values were as follows: duration spent in their current employment was eight years (range: 0.17-43 years), duration spent at the current hospital was also eight years (range: 0.17-41 years) and the median duration employed by the KZN DoH was nine years (range: 0.17-41 years).

Table 6: Occupational exposure of the study population

Variable	N	%
Co-workers with TB:		
Yes	86	74.1
No	30	25.9
Individuals suspected of TB:		
Daily	110	94.8
Weekly	1	0.9
Monthly	0	0
Unknown	5	4.3
Individuals with confirmed TB:		
Daily	109	94
Weekly	1	0.9
Monthly	1	0.9
Unknown	5	4.3

Table 6 indicates the occupational exposure of the participants to TB. The study indicated that 74.1 percent of participants knew of fellow co-workers that had acquired TB previously, with the median being one person (range: 0–10 people) known to the participant. Participants indicating that they were exposed on a daily basis to individuals suspected of TB and to individuals with confirmed TB made up 94.8 percent and 94 percent of the study population, respectively.

Table 7: Control measures noted by the study population

Variable	N	%
***Use of personal protective equipment (masks):**		
Yes	78	67.2
No	38	32.8
***Air conditioning:**		
Yes	101	87.1
No	15	12.9
Natural ventilation:		
Yes	18	15.5
No	98	84.5

Exhaust fans:		
Yes	2	1.7
No	114	98.3
Total	116	100

* The types of personal protective equipment used have been included in table 8.

With regard to the availability of masks, 67.2 percent of participants indicated that they were provided with masks at their places of employment. The usage, training and replacement of masks were also determined. Table 8 indicates the responses in terms of the usage and availability of the various types of masks in hospital environments, in order to determine accumulated exposure.

Table 8: Masks used by the study population

Type of Mask	Paper (%)	Surgical (%)	N95 respirator (%)	N99 respirator (%)
Provided:				
Yes	20.7	55.2	63.8	0
No	78.4	44.0	35.3	98.3
Training:				
Yes	5.2	17.2	36.6	0
No	94.0	81.9	65.5	98.3
Usage of Masks:				
Always	0.9	0.9	1.7	0
With infectious patients only	2.6	32.8	15.5	0
With TB patients	6.0	4.3	30.2	0
Not used	11.2	17.2	16.4	0
Not available	78.4	44.0	35.3	98.3
Replacement of Masks:				
After each patient	8.6	35.3	16.4	0
Daily	0.9	2.6	28.4	0
Weekly	0	0	2.6	0
Not used	11.2	17.2	16.4	0
Not available	78.4	44.0	35.3	98.3

The study indicated that N99 respirator were unavailable to all participants. The availability and usage of masks were as follow; only 20.7 percent of participants had paper masks available to them, however, 11.2 percent of these participants indicated that they did not use the paper masks; 55.2 percent had surgical masks available to them and 17.2 percent of these participants indicated that they did not use them; 63.8 percent of participants had N95 respirators

available to them; however, 16.4 percent of these participants indicated that they did not use these respirators.

Table 8 indicates that when dealing with infectious patients, 2.6 percent of participants used paper masks, 32.8 percent indicated that they used surgical masks and 15.5 percent indicated that they used an N95 respirator. When dealing with TB patients 6.0 percent of participants indicated that they used paper masks, 4.3 percent indicated that they used surgical masks and 30.2 percent of participants indicated that they wore N95 respirators. Participants always wearing masks made up 3.5 percentof the population (0.9 percent used paper masks, 0.9 percent used surgical masks and 1.7 percent used N95 respirators). Training in terms of paper masks was provided to 5.2 percent of participants, 17.2 percent of participants were trained to use surgical masks and 36.6 percent of participants were trained to use the N95 respirator.

Table 9: Time spent away from the department (median)

Median (1hour)	**N**	**%**
< 1 hour	8	6.9
≥ 1 hour	75	64.7
Does not spend time away from the department	33	28.4
Total	116	100

Environmental exposure in the radiology department was determined by results produced from questions related to ventilation within the department. Table 7 presented the results in terms of air-conditioning, natural ventilation and exhaust fans. Participants indicating that air conditioning was available in their departments made up 87.1 percent of the population. However, 37.6 percent of the 101 participants with air conditioning indicated that the systems did not work optimally. Of these systems, 63.8 percent were central cooling systems. The use of natural ventilation was noted by 15.5 percent of participants and the use of exhaust fans in departments were noted by 1.7 percent of participants. Table 9 indicates that participants leaving the radiology department during working

hours made up 71.6 percent of the study. An average of one hour away from the department was noted by 64.7 percent of participants.

Table 10: Previous occupational exposures to TB, dust or solvents

Previous Job Exposure		Yes	No
Job 1: (70 participants) 60.3%			
	TB Exposure	69.4	30.6
	Dust/Solvent Exposure	51.4	48.6
Job 2: (26 participants) 22.4%			
	TB Exposure	79.3	20.7
	Dust/Solvent Exposure	41.4	58.6
Job 3: (15 participants) 12.9%			
	TB Exposure	86.7	13.3
	Dust/Solvent Exposure	40.0	60.0
Job 4: (7 participants) 6.0%			
	TB Exposure	100.0	0.0
	Dust/Solvent Exposure	42.9	57.1

Participants indicating previous employment made up 60.3percentof the study population. Table 10 indicates the exposure of participants to TB and other dusts or solvents that may have been harmful to their respiratory systems. Job one indicates the most recent previous job. With regard to exposure, 69.4 percent of participants stated that they were exposed to TB whereas 51.4 percent indicated that they were exposed to harmful dusts or solvents in their most recent previous job.

Section C – Medical history data

The medical history of the group tested indicated the following in terms of general health, respiratory health, HIV status and TB symptoms and previous vaccines.

Figure 10 below indicates the general health of the tested group.

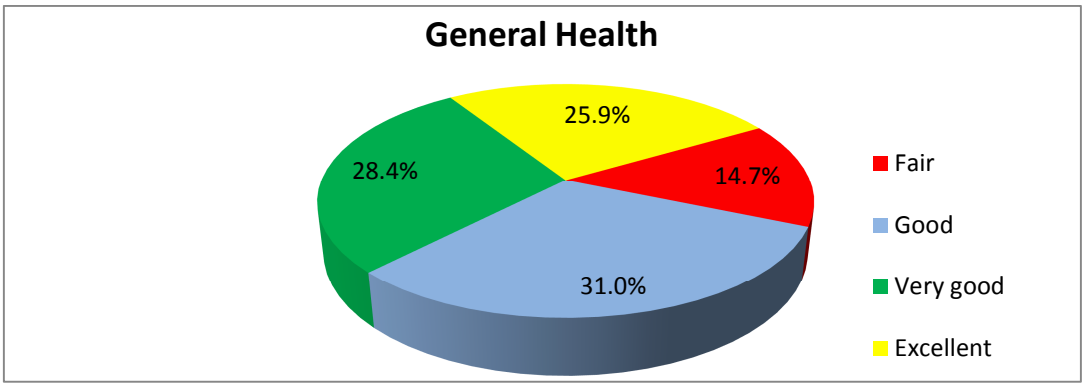

Figure 10: General health of the study population

Most participants responded that their health was “good”, at 31 percent, while 28.4 percent responded “very good” and 25.9 percent said “excellent”. The questionnaire also allowed for the collection of data relating to poor health statuses and HIV positive staff, however, these respondents were eliminated in the first phase of the study to prevent skewed TST results.

The following tables present the responses of participants in terms of their health, HIV statuses, the clinical symptoms of TB that they were experiencing and their vaccine history.

Table 11: Medical details of the study population

Variable		N	%
Participants with illnesses:	Yes	26	22.4
	No	90	77.6
HIV Status:	Negative	95	81.9
	Unknown	16	13.8
	Undisclosed	5	4.3
TB Symptoms: Night Sweats			
	Yes	4	3.4
	No	112	96.6
Weight Loss			
	Yes	5	4.3
	No	111	95.7
Cough > 2 weeks			
	Yes	0	0.0
	No	115	99.1
Haemoptysis			
	Yes	0	0.0
	No	116	100
Fever			
	Yes	1	0.9
	No	115	99.1
Lost more than 5kgs in the past month			
	Yes	2	1.7
	No	114	98.3
Indirect Symptoms of Immune Compromise:			
Clothes too big due to weight loss			
	Yes	4	3.4
	No	112	96.6
Last 3 months – diarrhoea> 3 days			
	Yes	1	0.9
	No	115	99.1
Last 3 months – fever > month at a time			
	Yes	0	0.0
	No	116	100
Last 3 months – white sores in the mouth			
	Yes	0	0.0
	No	116	100
Lymphadenitis (neck, groin/ under arms)			
	Yes	1	0.9
	No	115	99.1
Shingles			
	Yes	0	0.0
	No	116	100
Sever viral infection in the past month			
	Yes	0	0.0
	No	116	100
BCG vaccine at birth			
	Yes	100	94.8
	No	6	5.2
***Immunised with a live virus in the past month**			
	Yes	5	4.3
	No	111	96.6
Total		116	100

*Delays in sourcing a second trained professional to administer the TST. Participants included since vaccines were administered more than 3 months prior to TST.

Table 11 shows that 77.6 percent of the tested group indicated no illness. With regard to HIV testing and statuses, 85.3 percent of participants indicated that they were tested for HIV and 81.9 percent shared their statuses with us. All the participants that disclosed their statuses were HIV negative. Participants that did not know their HIV status made up 13.8 percent of the group and 4.3 percent of the group chose not to disclose their statuses. Participants that were positive were excluded at the first phase of the study.

The symptomatic history indicated that 100 percent of participants did not experience haemoptysis, a cough for more than two weeks, a fever for more than a month at a time, white sores in the mouth over the past three months, shingles in the past year or a severe viral infection in the past month. Night sweats, weight loss, swollen lymph nodes and diarrhoea for more than three days were experienced by 3.4 percent, 4.3 percent, 0.9 percent and 0.9 percent of participants, respectively. Participants indicating that they had lost more than five kilograms in the past month made up 1.7 percent of the population and 3.4 percent of participants said that their clothes had become too big for them due to their weight loss. Previous vaccination history was as follows: 94.8 percent of participants were made aware of their previous BCG vaccine administration by the researcher. This was due to scarring on the arm. 5.2 percent of the group did not display scars and were unaware of the vaccine administration; however, it is standard procedure for the BCG vaccine to be administered at birth in South Africa.

The respiratory health of the group is illustrated in figure 11, below.

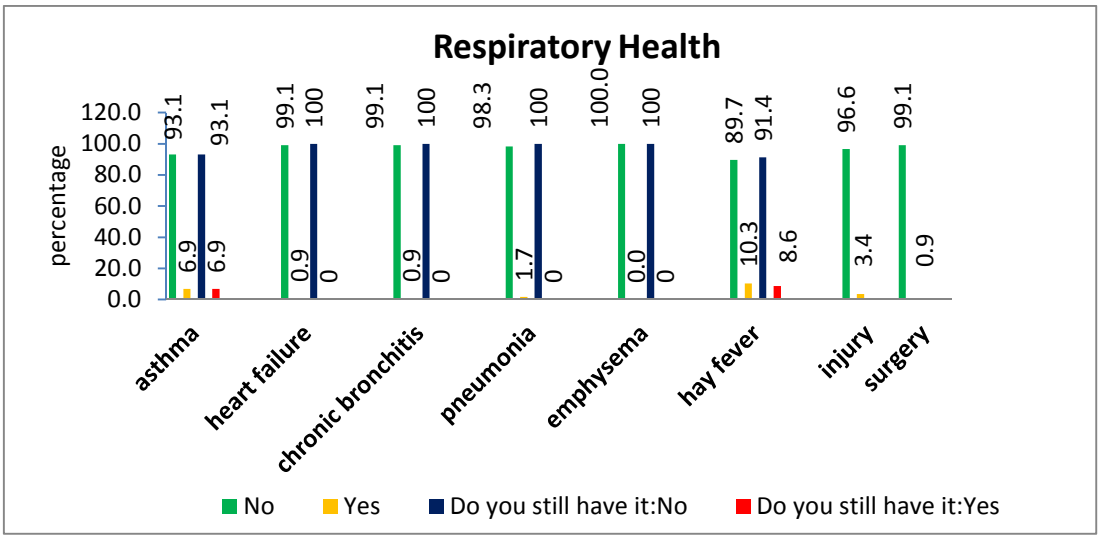

Figure 11: Respiratory health of the study population

Questions were asked in relation to different categories of illness in order to determine if participants had been diagnosed by a medical doctor, the age of diagnosis and if the participants currently suffered from the illness. The categories, as indicated in Figure 11, were asthma, heart failure, chronic bronchitis, pneumonia, emphysema and hay fever. The categories for previous chest injuries and surgery only requested participants to state if this had occurred.

With regard to respiratory health, participants were relatively healthy. Hay fever presented as the most common respiratory problem, with 10.3 percent of participants indicating that they were diagnosed with this illness during the course of life. Only 8.6 percent of the participants still suffered from hay fever. Asthma contributed to 6.9 percent of respiratory illness, with 100 percent of these sufferers still suffering from this illness. Previous heart failure, pneumonia and chronic bronchitis were noted in 0.9 percent, 0.9 percent and 1.7 percent of participants, respectively. All these participants indicated that they were not currently suffering from these illnesses. None of the participants indicated ever being diagnosed with emphysema. Previous chest injury and chest surgery was noted in 3.4 percent and 0.9 percent of participants, respectively.

Section D – Social history data

The social history of the group indicated the following in terms of social behavior as presented in Table 12, below:

Table 12: Social behaviours of the study population

Variable		N	%
Regular smoker:	**Cigarettes**		
	Yes	16	13.8
	No	100	86.2
	Pipe		
	Yes	0	0.0
	No	116	100
	Cigars		
	Yes	2	1.7
	No	114	98.3
Consumes Alcohol			
	Yes	44	37.9
	No	72	62.1
Total		116	100

Section E – Home and family history data

With regard to home and family history, the tested group disclosed the following information:

Table 13: Home and family history of the study population

Variable		N	%
Type of Housing			
	Urban formal housing	100	86.2
	Urban informal housing	11	9.5
	Hostel housing	4	3.4
	Squatter housing	0	0.0
	Rural housing	1	0.9
Electricity in the home			
	Yes	114	98.3
	No	2	1.7
***What source of power do you use**			
	Electricity	114	98.3
	Gas	6	5.2
	Wood	0	0.0
	Paraffin	0	0.0
	Solar	1	0.9
How many people at home (median coded)			
	< 4	46	39.7
	> = 4	70	60.3
****Do you share your bedroom**			
	Yes	73	62.9
	No	43	37.1
Sole bread winner			
	Yes	39	33.6
	No	77	66.4
Annual Income (median coded)			
	< R 200 000	56	48.3
	> = R 200 000	60	51.7
Does your home have:			
Central heating			
	Yes	1	0.9
	No	115	99.1
Ducted heating			
	Yes	0	0.0
	No	116	100
Air conditioning			
	Yes	50	43.1
	No	66	56.9
Does your home have natural ventilation			
	Yes	116	100
	No	0	0.0
Total		116	100

Data recorded on the participants housing revealed that 86.2 percent of participants lived in urban formal housing, 9.5 percent of participants indicated that they lived in urban informal housing, 3.4 percent indicated that they lived in

hostel housing and 0.9 percent indicated rural housing as the type of dwelling. Electricity was the main source of power for 98.3 percent of participants. Gas was a source of power for 5.2 percent of participants and solar power was used by 0.9 percent of participants. All participants indicated that they did not have ducted heating in their homes, whereas only 0.9 percent indicated that they had central heating. Air-conditioning in the homes was common in 43.1 percent of the participants.

Table 14: Ventilation (median value) in the home

Variable	N	%
How many windows in the home (median coded)		
< 10	47	40.5
>= 10	69	59.5
Total	116	100

Natural ventilation was found in all participants homes. The number of windows ranged from two to thirty windows in the home. The average number of windows in a home was 10, with 59.5 percent of participants indicating that they had 10 or more windows in their homes.

Table 15: Participants sharing a room

Variable	N	%
Does not share a room	43	37.1
Shares with 1 other person	68	58.6
Shares with 2 other people	2	1.7
Shares with 3 other people	3	2.6
Total	116	100

**M* =1 other person sharing a room. Range 0-3 people sharing a room

On average, the population study indicated a median of four people in the home (range: 1- 10 people), with 60.3 percent of participants indicating at least four people living at home. Participants also answered questions with regard to sharing bedrooms. 37.1 percent of participants did not share rooms.

Table 16: The number of people employed

Variable	N	%
Sole bread winner	39	33.6
1 other person employed	45	38.8
2 other people employed	21	18.1
3 other people employed	10	8.6
4 other people employed	1	0.9
Total	116	100

**M* = 1 other person employed. Range 0 - 4 other people employed

In terms of income, 51.1 percent of the population earned an annual income of R 200 000 or more. This was the average income earned by the study population, with the income ranging from R 62 000 to R 360 000. The study population being dominated by diagnostic radiographers is the primary reason for this average. Most participants (66.4 percent) indicated that they were not the sole bread winners in their family.

The data reflecting a detailed history of family members with TB was as follows:

Table 17: Family members with TB

Variable		N	%
Family members with TB			
	Yes	22	19
Type of TB			
	Pulmonary	21	95.5
	Extra-pulmonary	1	4.5
Duration of treatment			
	1 week	1	4.5
	6 months	18	82
	18 months	1	4.5
	None	1	4.5
	Unknown	1	4.5
Treatment outcome			
	Completed	16	72.8
	Defaulted/Passed away	2	9.1
	On treatment	1	4.5
	Passed away	3	13.6
Do they live with you			
	Yes	10	45.5
	No	12	54.5
Total		22	100

Participants indicating knowledge of family members with TB made up 19 percent of the study population. Relatives with pulmonary TB (95.5 percent) and extrapulmonary TB (4.5 percent) were noted. 45.5 percent of these relatives lived with participants of this study.

4.2.2 Tuberculin skin test data

The results presented below include the results obtained from phase 2 of the study, the two-step TST.

Table 18: TST result – step 1

Variable (step 1)	N	%
Positive TST	100	86.2
No Reaction	16	13.8
Total	116	100

**M* = 13.0. Range 0-22mm

The results of the first step of the TST indicated that 86.2 percent of participants were latently infected with TB. The average size of induration was 13mm, ranging from 0mm to 22mm. All participants that tested positive for the TST presented with indurations of 11mm or more. The second step of the TST procedure was performed on the 16 participants that tested negative (no reaction) during the first step. Only one conversion from negative to positive was noted.

Table 19: TST result – step 2

Variable (step 2)	N	%
Positive TST	1	6.7
No Reaction	15	93.3
Total	16	100

* *M* = 0.0Range 0-11mm

4.3 Bivariate analysis

Chi-square tests were performed on the categorical variables to determine associations with the status (the inclusion or exclusion) of the participants. This determined if participants were included into the study due to any specific factor. Categorical variables included demographic (age, gender, race, marital status, academic qualifications and place of birth) and occupational (occupation and health facility) variables. The following table presents the odds ratios estimates of the categorical variables in terms of reasons for exclusion or inclusion into the study. Where more than two variables were available, a reference group was selected. Annexure H illustrates the odds ratio estimates for the non-reference groups.

Table 20: Odds ratio estimates of categorical variables with the status of exclusion or inclusion

Category*	Group	**OR(95%CI)**	***p*-value**
Academic	Less than Matric	**Reference group**	
	Matric Certificate National Diploma Undergraduate Postgraduate	3.800 (0.590-24.462) 4.400 (0.419-46.263) 1.833 (0.491-6.843) 3.000 (0.127-70.877) 1.800 (0.368-8.800)	0.160 0.217 0.902 0.496 0.726
Age	20-<30	**Reference Group**	
	30-<40 40-<50 50-<60 60-<70 70-<80	0.547 (0.230-1.299) 0.593 (0.245-1.435) 0.413 (0.167-1.021) 0.527 (0.079-3.515) 1.080 (0.041-28.149)	0.172 0.247 0.056 0.508 0.963
Sex	Male	**Reference Group**	
	Female	1.275(0.464-3.502)	0.6375
Health Facility	District	**Reference Group**	
	Regional	0.929 (0.371-2.323)	0.874
Marital Status	Single	**Reference Group**	
	Divorced Widowed Married	0.983 (0.044-21.852) 0.190 (0.034-1.065) 1.117 (0.429-2.907)	0.991 0.059 0.821
Place of Birth	Republic of South Africa	**Reference Group**	
	Foreign birth	1.449 (0.072-29.005)	0.808
Job Title	Diagnostic Radiographers (all levels)	**Reference Group**	
	Support Staff	0.285(0.151-0.541)	0.001

*Race was not included into the table as a reference group could not be selected. This is included into the non-reference group table in Annexure I. No significant associations were noted.

The odds ratio estimates were performed to determine if any group of individuals were more or less likely to be included or excluded into this study, as compare to other groups. Determining if a group was more likely to be excluded from the study implied that the group was more likely to meet the exclusion criteria of phase two. This included a positive history of TB.

No significant relationship was found between the academic history, age, gender, health facility that they worked at, and place of birth with their status of inclusion or exclusion. The job title of diagnostic radiographers (all levels) versus support staff displayed a *p*-value of 0.001. The odds of exclusion of diagnostic radiographers were 28.5 percent less than in support staff, with the true population effect being 54.1 percent and 15.1 percent. This result was significant; however this may have arisen by chance due to the small *p*-value noted above.

When performing odds ratio estimates of all variables (non-reference groups in Annexure I), the job title of Manger/Assistant Manager displayed statistically significant results when compared with General Assistants/Porters, “Other” staff and Darkroom Operators. The *p*-values were 0.002, 0.043 and 0.026, respectively. The odds of exclusion of Managers/Assistant Managers were 6.8 percent less than in General Assistants/Porter, with the true population effect being 36.7 percent and 1.3 percent; with “Other” staff, the odds of exclusion of Managers/Assistant Managers were 18.8 percent less, with the true population effect being 94.6 percent and 3.7 percent; and with Darkroom operators, the odds of exclusion of Managers/Assistant Managers were 18.8 percent less, with the true population effect being 81.6 percent and 4.3 percent. This indicates that Managers/Assistant Managers were more likely to be included into the study. In terms of exclusion criteria, a positive history of TB was a key factor. This implies that it was less likely for Managers/Assistant Managers to be excluded due to a history of TB disease, implying that General Assistants/Porters, “Other” staff and Darkroom Operators were more likely to have TB disease and thus be excluded from this study.

This result is in keeping with the odds ratio of diagnostic radiographers when compared to some support staff. Statistically significant results were noted when comparing Diagnostic Radiographers to Darkroom Operators (*p*-value = 0.021) and General Assistants/Porters versus Diagnostic Radiographers (*p*-

value = 0.001). The odds of exclusion of Diagnostic Radiographers were 32.1percent less than in Darkroom Operators, with the true population effect of 84.0 percent and 12.3 percent. General Assistants/ Porters were 8.6 times as likely as Diagnostic Radiographers to be excluded. With a wide confidence interval (2.423-30.211) noted for this output, little knowledge about the effect could be stated; and with a low *p*-value (0.001) the probability of obtaining a significant effect may have arisen by chance. These results indicate that diagnostic radiographers have a greater chance of being included into the study (having a less chance of TB disease) and Darkroom Operators and General Assistants/Porters are more likely to have TB disease and thus be excluded. The odds of exclusion of Administrators compares to General Assistants/Porters also displayed a significant result (*p*-value = 0.046), where the chance of exclusion for administrators was 26 percent less than in General Assistants/Porters, with the true population effect being 97.5 percent and 6.9 percent.

The significant odds ratio estimates for demographic categories were seen in race and marital status. The Indian versus White races displayed the odds of exclusion of Indians from the study by 16.4 times less than with the White race. The true population effect was 92.9 percent and 2.9 percent, respectively. This result was significant (*p*-value = 0.041). This indicates that Indian participants were more likely to be included into the study. In terms of marital status, widowed participants were 5.9 times as likely as married participants to be excluded from the study. With a wide confidence interval (1.024-33.868) noted for this output as well, little knowledge about the effect can be stated. This result was significant with a *p*-value of 0.047.

Bivariate correlations were also performed on the (nominal) data. Spearman rho' correlation co-efficient was computed to assess the relationships between the independent variables and against the dependent variable. This can be viewed as a table in Annexure H. Positive values indicated a directly

proportional relationship between the variables and a negative value indicated an inverse relationship. All significant relationships are indicated by a * (the correlation is significant at the level of 0.05) two-tailed or ** (the correlation is significant at the level of 0.01) two-tailed.

The results indicated the following associations in terms of occupational factors: Positive correlations with the size of the first induration (*M* =13) included the duration in current employment (*M* =8 years): r (116) = 0.228, *p*< 0.05 (0.014); duration in current hospital (*M* = 8 years): r (116) = 0.200, *p* < 0.05 (0.031) and; the duration employed by the KZN DoH (*M* = 9 years): r (116) = 0.243, *p* < 0.01 (0.009). These results indicate that an increased time spent employed in the current employment, current hospital and employed by the KZN DoH resulted in an increased size of the induration of the first TST.

The size of the second induration(*M* = 0.0) and the number of other people employed *(M* = 1) in the home indicated a negative correlation: r (116) = -0.677, *p*< 0.05 (0.011). This implies that participants that tested positive for the second TST were more likely to be the sole bread winner or have a fewer number of other people employed, that live in their home.

The duration in current employment(*M* = 8 years), current hospital (*M* = 8 years) and the duration employed by the KZN DoH (*M* = 9 years) displayed positive correlations with the marital status of participants: r (116) = 0.367, *p* < 0.01 (0.00); r (116) = 0.364, *p* < 0.01 (0.00); and r (116) = 0.475, *p* < 0.01 (0.00), respectively; and age: r (116) = 0.396, *p*< 0.01 (0.00); r (116) = 0.604, *p*< 0.01 (0.00) and r (116) = 0.507, *p* < 0.01 (0.00), respectively. These findings indicate that older participants and married participants were more likely remain in their current jobs, the current hospital and be employed by the KZN DoH for a longer period of time. The duration in current employment (*M* = 8 years) also demonstrated positive correlations with the time spent employed at the current hospital ((*M* = 8 years): r (116) = 0.691, *p* < 0.01 (0.00); the duration employed

by the KZN DoH (*M* = 9 years): r (116) = 0.688, *p*< 0.01 (0.00) and the number of people known to the participant that has been diagnosed with TB: r (1116) = 0.204, *p* < 0.05 (0.030).

The average hours spent with individuals suspected of having TB (*M* = 8 hours) and the average hours spent with TB cases (*M* = 8 hours) indicated identical negative correlations with age (*M* = 36 years): r (116) = -0.400, *p* <0.01 (0.00); gender: r (116) = -0.212, *p* <0.05 (0.026); marital status: r (116) = -0.265, *p*< 0.01 (0.005), the duration employed at the current hospital (*M* = 8 years): r (116) = -0.326, *p*< 0.01 (0.001); and the duration employed by the KZN DoH (*M* = 9 years): r (116) = -0.234, *p*< 0.05 (0.014). This implies that newly employed, single, younger females were more likely to spend longer times with TB cases and individuals suspected of having TB.

The following associations in terms of demographic factors were demonstrated: There was a positive correlation between the age (*M* = 36 years) of participants and the size of the first induration (*M* =13): r (116) = 0.257, *p*< 0.01 (0.005). These results indicate that older participants were more likely to have larger indurations than younger participants. A negative correlation was made with the number of other people employed in the participants home (*M* =1): r (116) = -0.225, *p*< 0.05 (0.015).

Positive correlations with race included the number of people living in the home (*M*= 4): r (116) = 0.234, *p* < 0.05 (0.011) and the number of windows in the home (*M* = 10): r (116) = 0.255, *p* < 0.01 (0.006).

The number of people living in the participant's home (*M* =4) displayed positive correlations with the number of people that the participant shares a bedroomwith (*M* =1): r (116) = 0.254, *p* < 0.01 (0.006) indicating that it is more likely for participants to share a room when there were four or more than four occupants in a household. This is significant in this study as high congregate

settings have been known to increase the rate of transmission of TB. Household contact studies systematically reviewed by Morrison, Pai and Hopewell (2008) determined the risk of LTBI and active TB disease in close contacts of people with pulmonary tuberculosis in low- and middle-income countries. The findings of their review (2008: 359) stated that closeness of contact and duration of exposure to infectious sources are some of the factors that govern the transmission of *MTB*.

Positive correlations with the number of people living in the participant's home (*M* =4) and the number of other people employed in the home displayed associations with the number of windows found in the home (*M* =10): r (116) = 0.228, *p*< 0.01 (0.014) and r (116) = 0.305, *p* < 0.01 (0.001), respectively. This indicates that the likelihood of more windows in a home may result from more people being employed and the more people living in the home. Negative correlations with the number of windows in the participants home included the duration spent in the current employment of participants (*M* = 8 years): r (116) = -0.207, *p*< 0.05 (0.026).Participants that were employed for a shorter period of time were more likely to have a fewer number of windows in their home.

4.4 Multivariate Linear Regression Analysis

Multiple linear regression analysis was used to develop a model for predicting the associations of independent variables with the size of the first induration, indicating LTBI. The predictors for the multivariate analysis were captured as follows:

- Do you wear the PPE provided?,
- Average hours with TB cases (hours),
- How many people live in your home?,
- Generally healthy, Gender,
- Duration employed in KZN DOH (years),
- How many do you know have been diagnosed with TB?,
- What is your annual income?,

- Have any of your family members been diagnosed with TB?,
- What is your current job title?,
- Do you smoke cigarettes,
- Do you drink alcohol? and;
- Age.

The SPSS Model indicated that one model was reported.

Table 21: Model Summary

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	0.473	0.223	0.124	569769

The proportion of variance in the dependent variable predicted from the independent variables was 22.3 percent. This indicates that 22.3 percent of the variance in the size of induration can be predicted from the dependent variable. Findings indicated that the overall equation was found to be statistically significant (F= 2.257, $p < 0.012$). It can be concluded that the predictors can be used to give a good indication of performance since the significance value is less than 0.05. In this case, since the *p*-value is less than 0.05, it can be said that the independent variables do predict the dependent variable.

Table 22: Associations between LTBI (size of first induration) and predictors in the multivariate analysis

Risk Factor	β	Standard Error (SE)	*t*-value	*p*-value
Demographic Risk Factors				
• Age	0.017	0.090	0.093	0.926
• Gender	0.068	0.065	0.650	0.517
Occupational Risk factors				
• Current Job Title	0.079	0.906	0.818	0.415
• Average hours with TB cases.	0.027	0.026	0.284	0.777
• Duration employed in KZN DoH.	0.208	0.107	1.151	0.252
• Do you wear PPE	-0.046	0.057	-0.494	0.623
• Co-workers with TB	0.101	0.043	1.104	0.272
Medical Risk Factors				
• Generally Healthy	-0.124	1.577	-1.349	0.180
Socio-economic Risk Factors				
• Annual Income (200 000)	0.191	0.000	2.002	0.048
• Smokes	-0.136	0.086	-1.325	0.188
• Drinks alcohol	0.223	0.061	2.167	0.033
House-hold Risk factors				
• How many people live in your home	-0.007	0.359	-0.074	0.941
• Family members diagnosed with TB	-0.184	0.070	-1.933	0.056

From the multivariate analysis, alcohol consumption (β= 0.223, p< 0.033) and the annual incomes of the participants (β = 0.019, p < 0.048) were found to be the only two independent variables with a significant impact on the size of the first TST induration. This indicates that participants that consume alcohol and participants with higher incomes are more likely to have larger TST indurations. The other variables did not meet the necessary criteria to significantly impact on the size of the first induration. It is however, important to note that having family members with TB did approach the level of significance (β= -0.184, p < 0.056).

4.5 Conclusion

The assessment of 116 radiology staff in terms of occupational and demographic factors associated with LTBI has generated adequate data to describe these associations within the eThekwini Health District of Kwa-Zulu Natal. Data was captured and analysed for all three objective of the study. The results highlighted significant associations between LTBI and demographic and occupational factors.

Chapter 5 discusses and describes the findings of the study in line with the study objectives.

CHAPTER 5

DISCUSSION

5.1 Introduction

This chapter provides a detailed discussion on the results of the study in keeping with the three main objectives.

5.2 The prevalence of Latent Tuberculosis Infection in radiology staff

The prevalence of LTBI in radiology staff has been highlighted in the results chapter, with 86.2 percent of participating radiology staff testing positive during the first step of the TST. The two-step TST method, recommended for testing vulnerable risk groups (including HCW's) displayed a high prevalence of LTBI. In comparison with the estimates noted by Joshi *et al*. (2006) in their systematic review of TB among healthcare workers in low- and middle-income countries, this study indicates a higher prevalence of LTBI. The prevalence of LTBI noted by Joshi *et al*. (2006) ranged from 33 percent to 79 percent, therefore an elevated LTBI prevalence of 86.2 percent in the eThekwini health district of KZN has been observed. This elevated prevalence of LTBI in radiology staff differs from the results in other South African studies conducted by van Rie*et al*. (2011) on medical students and HCW's in Johannesburg and Shanaube*et al*. (2011) who conducted studies on 24 high prevalence HIV and TB communities in South Africa and Zambia. The prevalence of LTBI in these studies indicated statistics of 56.7 percent and a range of 24-77 percent, respectively.

Although the LTBI prevalence in this study is higher than those seen in similar studies, the lack of current data on LTBI prevalence in the particular communities or populations used in this study can be considered a limitation. This is noted in the study conducted in the Western Cape Province of South Africa by Shanaube*et al.* (2011). In their study, a community could only be defined as a population consisting of a minimum of 250 000 people with access

to the same diagnostic centre. Therefore, in a country such as South Africa where varying levels of burden of disease are noted (Van Rooyen and Brink 2007: 107), the prevalence of LTBI between provinces in South Africa will vary; and may even conflict with regional estimates within each province due to varying incidences of both TB and HIV infection among communities.

With the eThekwini Health District displaying the highest levels of TB, as stated by the Ministry of Health in 2011; the impact of HIV co-infection and the MDR-TB and XDR-TB outbreaks, the likelihood of an elevated finding of LTBI in radiology staff can be rationalized. Cohen *et al.* (2010: 3) state that TB in KZN is recognized as a primary cause of early death. The incidence of TB in South Africa has increased dramatically between 1990 and 2007, primarily due to the increase in HIV prevalence (Cohen *et al.* 2010: 2). Churchyard *et al*. (2014: 245) indicate that the mortality rate of TB patients in South Africa remains high even after the completion of TB treatment. The probability of HIV co-infection was considered to be the most likely cause of death (Churchyard *et al*. 2014: 245). The South African Health Review (Department of Health 2013: 69) indicates that it is necessary to recognize HIV infection as a risk factor, primarily due to the 60 percent HIV prevalence amongst the incident TB cases in South Africa. In 2002, the overall HIV prevalence was 16 percent amongst HCW's (Department of Health 2013: 198). This supports the current findings of an elevated LTBI prevalence in the eThekwini Health District of KZN due to the high levels of HIV and TB co-infection in HCW's.

The impact of both occupational and demographic factors on LTBI has been highlighted in this study. Occupational factors assessed in this study included: profession/occupation, the years and place of employment, the average time spent with individuals suspected of or confirmed TB, exposure to co-workers with TB, the use of masks and the assessment of ventilation parameters and exposure to natural ventilation. The demographic data of the participants included: gender, age, race, marital statuses, academic qualifications, social

behaviour, family history and household exposure and medical history. Participants indicated exposure from family members (19 percent) and from co-workers (74.1 percent). The associations of these factors with LTBI in radiology staff are discussed further below. The findings of the study support the hypothesis that there is a high prevalence of LTBI within the radiology departments of regional and district public sector hospitals in the eThekwini Health District of Kwa-Zulu Natal.

5.3 Demographic data of Health Care Workers

The South African Health Review (Department of Health 2013: 97) states that the health inequities between and within countries are a result of various social determinants. Basu*et al.* (2012: 8) observed in their study a noticeable trend of poor patients in South Africa being unable to access private sector facilities. The social and economic factors influencing health inequities include income, education, social safety networks, employment and working conditions, unemployment and job security, early childhood development, gender, race, food insecurity, housing, social exclusion, access to health services, and disability. Due to South Africa facing social and economic transformation since 1994, gender, race and geographical location remain the main categories of social and economic inequities and poor health outcomes, exacerbated by the quadruple burden of disease.

In 2011 Report 03-00-05 (Statistics South Africa 2011: 42) aimed to provide information on the use of health facilities (in terms of access and utilisation) and the levels and patterns of selected health conditions of the South African population based on findings from the General Household Survey conducted in 2011. The results indicated that 2.9 percent of the people who said they were ill or injured a month before the survey suffered from TB or severe cough with blood. Significant differences were observed by age, sex, population group and province of usual residence. TB was common in age groups, between 25-64 years of age. Young children and the elderly seemed to be less affected. The

highest prevalence of TB or a severe cough with blood was in the age group between 45 to 54 years of age. In terms of gender, the percentage of males with TB or severe cough with blood was higher (3.8 percent) than that of females (2.2 percent) (Statistics South Africa 2011: 43). The results by province of usual residence indicated that TB was highest in KwaZulu-Natal (6.3 percent) when compared to all other provinces. Western Cape (1.9 percent), Gauteng (1.8 percent) and Limpopo (1,2 percent) had the lowest percentages.

Lawn and Zumla (2011: 68) state that despite worldwide progress in TB control, the rate of TB decline is less than 1 percent per annum. The reasons behind this according to Lawn and Zumla are the consistent changes in factors that render the population at risk. These include social and economic factors as well as the general health of the population. Other reasons include the late diagnosis of TB having intensified effects on transmission rates. In South Africa, in order to reach global targets by 2050, the annual incidence should decrease by approximately 16 percenthowever, this is unlikely to happen in South Africa. The estimated global TB incidence rate will still remain 100 times higher than the elimination target in 2050 even if the Global Plan to Stop TB was successfully implemented.

According to Lin and Flynn (2010: 15), latently infected individuals serve as the largest reservoir for potential transmission of MTB. The concern with most of these patients is the risk of reactivation (active TB after remote infection) and the ensuing spread to close contacts. Studies by Lin and Flynn (2010: 19) and Lönnroth*et al.* (2009: 2244) have shown that the risk of developing TB among HCW's is dependent on certain risk factors. These predisposing demographic factors are noted in Figure 12, below:

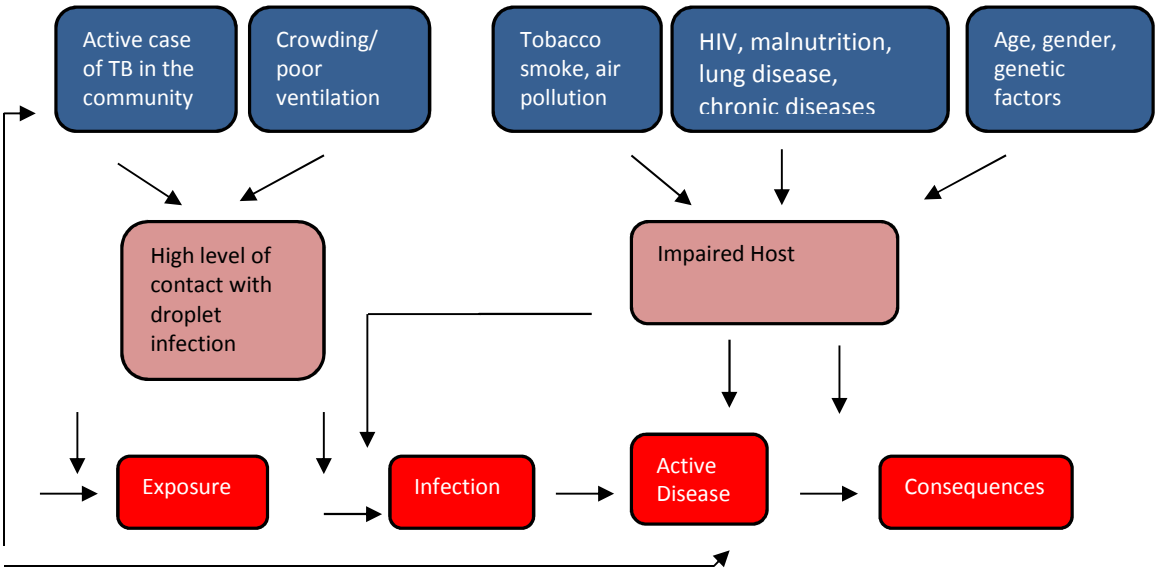

Figure 12: Predisposing risk factors (Lönnroth*et al.* 2009: 2244).

The results of the demographic data of the study population will be used to discuss the findings in terms of the predisposing risk factors noted above.

5.4 Associations of demographic data with Latent Tuberculosis Infection

Demographic data revealed that 69 percent of the study population was female. With 62.1 percent (48.3 percent being diagnostic radiographers and 13.8 percent being managers/assistant managers) of the study population indicating radiography as a profession, the probability of the (7:1) female to male ratio was anticipated. This is in keeping with the researcher's observations of radiography being a predominantly female occupation. This may be the key to significant findings of this study that indicated that female participants spent more time with TB cases and individuals suspected of TB when compared to males (p = 0.026). Research in professions that are male dominated may display inverse results. Although the association of the male sex with increased *MTB* infection risk has been noted in studies by Casas *et al.* (2011) and Rafiza, Rampal and Tahir (2011), this was not observed in this study. Studies by Demkow*et al.*

(2008: 212) and He *et al.* (2010: 7) also observed no association of gender with LTB in their studies.

In terms of age, most participants (31.9 percent) were between the ages of 20 to <30 years of age. The percentage progressively decreased as participants got older and the average age of participants was 36 years. The bivariate correlations performed on the nominal data indicated numerous associations with age. The most significant association in this study was the size of the first induration (median) with the age of participants (median) {p = 0.005}. Older participants (≥36 years) displayed indurations of ≥ 13mm when compared to younger participants (<36 years). The increasing prevalence of LTBI with older age is in keeping with studies by Mathew *et al.* (2013: 72); Casas *et al.* (2011: 544); Shanuabe*et al.* (2011: 7); and Demkow*et al.* (2008: 213). These findings contradict studies from India (Pai and Christopher 2011: 198) and South Africa (Naidoo and Jinabhai 2006: 679) where younger HCW's were found to be the most vulnerable groups.

Increasing age (≥ 36 years) was associated with the marital status of participants and the number of employed people living at home. Older participants were married and had fewer employed people living at home. Increasing age was also associated with the duration spent employed in their current jobs, the duration of time spent at the current hospital and the average time employed by the KZN DoH. Older participants were more likely to remain in their current jobs for a longer period of time rather than younger participants.

Participants born in the Republic of South Africa made up 97.4 percent of the study, with 2.6 percent of participants being of foreign decent. Indians (52.6 percent) constituted more than half of the group tested. Africans constituted the second highest amount at 37.9 percent and Coloureds and Whites followed at 6.9 percent and 2.6 percent, respectively. The study indicated that approximately half of the respondents (47.4 percent) had a National Diploma.

With nearly half the respondents (48.3 percent) being diagnostic radiographers, this is to be expected, as the minimum qualification of a radiographer in KZN is a National Diploma. Further studies in KZN or studies in Gauteng may indicate higher levels of education due to the fact that the university in KZN will be introducing a four-year degree, and one university in Gauteng, already has this new qualification in place. The demographic data indicates a well-qualified, experienced and mature set of respondents, with 75 percent of participants indicating possession of some tertiary level education. This is useful as the responses obtained would be (mostly) from a grouping who fully comprehends the nature of this experiment, thereby increasing reliability.

Participants (19 percent) indicated that family members were infected with TB. According to Verver*et al.* (2004: 212) the prevalence of TB infection among household contacts of individuals with TB is high. Augustynowicz-Kopéc*et al.* (2012: 597) state that the risk of infection increases with the proximity and duration of exposure to the source of infection. The median value for the number of people living in a household was four. Just over 60 percent (60.3) of participants indicated that at least four people, including themselves, lived in their home. The multivariate analysis indicated that having family members with TB did approach the level of significance (β= -0.184, $p < 0.056$).

The marital status of participants was associated with the number of people in a home. With the average age of participants being 36 years, the likelihood of most married participants having families is expected. Associations between the average time spent employed by the KZN DoH, the average time at the current hospital and the average time employed in the current job were made with marital status. Participants that were married were more likely to remain within the same environment for longer periods of time.

Participants indicating that they shared a room, with at least one other person in their home, made up 62.8 percent of the study population. Marital status and

the average number of people living in a home (four people) were associated with the average number (one other person) of people that share a bedroom. This is a logical and expected finding; however the risk of transmission to household contacts may be high due to the communal living situations of participants. Studies conducted in South Africa by Harling, Ehlrich and Myer (2008: 493) and Shanuabe*et al.* (2011: 9) recognized that the transmission of TB in high incidence settings does not only occur within households but within the community as well.

Most participants (86.2 percent) indicated that they lived in urban formal housing and were not the sole bread winner of the family (67.2 percent). The findings of this study indicated that natural ventilation obtained in the home was primarily through windows. The number of windows in the home was associated with the number of people living in the home, the number of employed people at the home and the annual income of the participants.

Social behaviours indicated that 37.9 percent of participants consumed alcohol and 13.8 percent of participants were smokers. Studies by den Boon *et al.* (2005: 555) and He *et al*. (2010: 6) indicate that the risk of LTBI in smokers is higher than in non-smokers. Harling, Ehlrich and Myer (2008: 496) indicated the association of TB with socio-economic status. Behavioural risk factors in their study included alcohol consumption, smoking and a lowered body-mass index. The multivariate analysis in this study indicated that alcohol consumption (β= 0.223, p< 0.033) had a significant impact on the size of the first TST induration. Medical and respiratory health indicated no associations with LTBI.

5.5 Occupational factors affecting Health Care Workers

According to Naidoo *et al.* (2013: 176) South Africa remains the third highest country for TB disease despite being the most resourced country in Africa. The challenges of HIV and TB that South Africa faces are exacerbated by an overburdened public health sector (Finlay *et al.* 2012: 2). Gandhi *et al.* (2010:

1830) state that the appearance of MDR-TB and XDR-TB over the past 20 years threatens TB control since it raises the possibility of drugs no longer being effective. MDR-TB and HIV co-infection has a high early mortality rate, especially in low-income settings (Gandhi *et al*. 2010: 1830).

In KZN, HCW's are two times more likely to acquire drug resistant TB as compared to HCW's from other provinces (Dludla and Bateman 2012: 649). South African hospitals in the eThekwini health district see numerous TB, MDR-TB and XDR-TB patients due to the provinces statistics of MDR-TB being the highest globally (Dludla and Bateman 2012: 649). As in India (Mathew *et al.* 2013: 67), possible downfalls in hospitals settings may be the cause of delays in diagnosis and treatment of TB patients, primarily due to the under-utilization of available rapid diagnostic techniques, failure to isolate infectious TB cases routinely and unrecognized drug resistance among a *MTB* strain.

According to van Rie*et al.* (2013: 853) the prevalence of LTBI in low- and middle-income countries ranges between 33 percent and 79 percent. This study indicated a higher LTBI prevalence of 82.6 percent. Studies by Joshi *et al.* (2006: 2376) associated the level of occupational exposure with the risk of acquiring TB. Demkow*et al.* (2008: 211) and Casas *et al.* (2013: 606) indicate that LTBI can be associated with occupational categories due to the level of occupational exposure. According to van der Walt *et al.* (2011: 1) HCW's are at high risk for TB infection due to repeated exposure to patients with infectious diseases. HCW's are exposed to both diagnosed and undiagnosed TB, the latter being more infectious due to the lack of TB treatment.

In HCW's where immune-compromising diseases are present, the risk of developing active TB disease is higher than in other staff (van der Walt *et al.* 2011: 1). Factors dictating the risk of TB among HCW's include the occupational category, age and the use of TB infection control measures. In the study performed by Naidoo *et al.* (2013: 179) primary care givers were also

noted to be a high risk group due to the close clinical contact spent with infectious patients. HCW's in outpatient departments were just as much likely to contract TB as those working in TB wards (Naidoo *et al.* 2013: 179). According to the National Core Standards for Health Establishments in South Africa, compliance with IPC is essential in order to reduce health care associated infections (Department of Health 2011c: 13).

5.6 Associations of occupational factors with LTBI

Occupational data revealed that occupational categories included radiography managers/assistant managers (13.8 percent), diagnostic radiographers (48.3 percent), administration staff (18.1 percent), darkroom attendants (10.3 percent), general assistants/porters (3.4 percent) and one other (nurses and cleaners) category (6.0 percent). The radiology department is primarily run by these categories of staff, therefore explaining the high level of response. The category labeled "other" indicates the nursing and cleaning staff. The time spent employed in their current employment ranged from three months (newly employed workers including community service radiographers) to 43 years. The average years of employment by the KZN DoH was nine years, with 44.8 percent of participants falling below the average years. Employment at the current job and current hospital averaged eight years, with 53.4 percent and 50 percent of participants indicating eight or more years, respectively.

Findings of the study indicated that participants were likely to remain in their current jobs at the current hospitals especially if they remained at their current hospital for the median duration of eight years. Associations of occupational factors with LTBI included longer durations in current employment and at the current hospital. The size of the first TST induration (median of 13mm) increased with years of employment. This correlation indicates that participants employed for more than eight years in their current job were more likely to test positive for LTBI, with indurations of 13 mm or more. The association of being employed at the current hospital also put participants at risk for LTBI.

According to Joshi *et al.* (2006: 2388) the cumulative effect of exposure to TB is commonly seen in older HCW's were the duration of employment as a HCW is the primary reason for LTBI. This cumulative effect has been noted in studies performed in Spain (Casas *et al.* 2011: 544), Portugal (Costa *et al.* 2010: 3), and Poland (Demkow*et al.* 2008: 212). In South Africa, increased time periods spent with an infectious patient increases the risk of TB, especially when patients are in the pre-chemotherapy phase (Zungu and Malotle 2011: 18). In terms of occupational exposure to TB, 94.8 percent of participants indicated that they were in contact with individuals suspected of TB on a daily basis and 55.2 percent of these participants indicated that they spent at least eight hours with these types of individuals. Confirmed TB contact was noted in 94.0 percent of participants and 55.2 percent of these participants indicated that they spent at least eight hours with these types of individuals.

Associations made with the average hours spent with individuals suspected of TB and individuals with confirmed TB displayed correlations with age, gender, marital status, duration in current hospital and duration employed by the KZN DoH. These displayed inverse relationships, where findings indicated that younger (p = 0.00), newly employed (p =0.014), single (p =0.005), female (p =0.026) HCW's were more likely to spend more time with individuals with suspected or confirmed TB.

On average, the annual income earned was R 200 000 ranging from R 62 000 to R 360 000. Considering that 62.1 percent of the study population was diagnostic radiographers, the average annual income was expected to be high. The multivariate analysis found that the annual income of the participants (β = 0.019, p < 0.048) had a significant impact on the size of the first induration. Higher income earners were more likely to have larger TST indurations. In this study, the higher income earners included the diagnostic radiographers (all levels). Even though Harling, Ehrlich and Myer (2008: 492), indicate that

poverty and low socio-economic status is associated with TB disease, this was not a finding in this study. The finding of higher income earners having larger TST indurations may be due to longer times spent with patients as compared to other staff in the radiology department. Harling, Ehrlich and Myer (2008: 492) indicate that lower income staff are at a higher risk due to the known associations of poverty with TB disease.

Cohen *et al.* (2010: 4) conducted a study in South Africa on autopsies of young adults dying at a hospital in KZN. Post mortem specimens indicated that almost half of the patients that died who were on TB treatment displayed signs of viable *MTB* and those patients not on treatment displayed evidence of TB via needle core biopsies. Cohen *et al.* (2010) highlighted the high mortality rates of HIV positive individuals infected with TB at hospitals in their study. It is necessary, however to consider the HCW's faced with these situations. The risk of TB infection in HCW's is high and according to Dludla and Bateman (2012: 649) the risk of drug resistant TB infection is higher. The results of our study indicated that 74.1 percent of participants were aware of at least one co-worker that had been infected with TB, with one of these being diagnosed within the last week of data collection. Associations were noted between the number of people known to participants to have contracted TB and the time they spent employed in their current jobs at the KZN DoH. This is an expected finding.

In terms of personal protective measures used by HCW's, questions were asked with regard to different types of masks. Participants provided with paper masks (20.7 percent), surgical (55.2 percent) and N95 (63.8 percent) indicated that they mostly used the masks when dealing with infectious or TB patients, however high rates of not using any form of mask were also noted. More than half of participants provided with paper masks (11.2 percent) did not use them. Surgical and N95 masks were not used by 17.2 percent and 16.4 percent of the participants that were provided with them. Possible reasons for not committing to infection control measures such as the usage of masks have been outlined

by the South African Health Review (Department of Health 2013: 199). This review reported that HCW's indicated that respirators were uncomfortable and had a suffocating nature. They found it difficult to breathe, especially those with personal health care problems, including pregnancy. This prevented HCW's from using the N95 respirators on a regular basis.

Training of HCW's in the usage of masks was also assessed in this study. Participants indicated that 5.2 percent, 17.2 percent and 36.6 percent were trained in the usage of paper, surgical and N95 masks, respectively. According to the South African Health Review (Department of Health 2013: 200), the training deficits were pitfalls in facility-specific policies. Most HCW's stated that apart from training obtained during tertiary education; they did not obtain any further in-service training within the hospital setting. The main aim of in-service training is to allow for HCW's to use the knowledge in practice, however, the main factors affecting TB infection control practices include the HCW's perception of their own risk and the training that they have received. If HCW's understand the level of risk that they are faced with, they are more likely to participate in training programs and implement TB infection control practices in a consistent manner.

According to Pai and Christopher (2011: 199) the apathy of HCW's in high burden settings, such as India, increase the risk of transmission of TB to themselves. This may be due to HCW's attitude towards inevitably contracting TB. In South Africa, this may also be the case. A study by van Rie*et al.* (2013: 854) indicated that 65.7 percent of HCWs believed they were likely or highly likely to have LTBI, and that 70 percent believed it was likely or highly likely that they would acquire LTBI in the next 5 years. With the bleak standpoint noted, it is necessary to ensure that HCW's are protected in every possible way. The need for improved annual screening and early diagnosis of TB among HCW's is vital for the retention of healthy staff within the public health sector.

5. 7 Limitations of the study

As a limitation to the study, it was noted that the radiologists and registrars were unable to participate. This was primarily due to a lack of time on their part to complete the questionnaires, which were an integral part of the study. The common response was a lack of time to participate due to an overload of clinical work with consultants and a lack of time due to upcoming examinations from registrars. The shortage of specialist doctors, including radiologists, in South Africa is a noted pitfall to the health system (Williams 2006: 14). According to Edge *et al.* (2014: 378) the WHO recommends an ideal physician: population ratio of 50:100 000. In Africa, the average is 18:100 000, primarily due to the loss of staff to emigration. Strachan, Zabow and van der Spuy (2011: 523) also state that few doctors choose to work in the public sector and the loss of professionals to emigration is a compounding factor in the lack of medical personnel. South Africa displays lower numbers of medical and dental professionals when compared to other middle-income countries. In 2011, only 27 000 doctors were available for a population of 48 million as compared to the 120 000 doctors for a population of 60 million in the United Kingdom (Strachan, Zabow and van der Spuy 2011: 523).

In 2001 South Africa's high commissioner to Canada made an appeal to the country to stop recruiting South African doctors due to a dire shortage in South Africa (Sullivan, 2001: 387). In 2006, the president of the Radiological Society of South Africa (RSSA), Richard Tuft, stated at the time, that there were approximately 450 radiologists in South Africa, which was enough to service the private sector, but insufficient for the public sector (Williams 2006: 15). This makes the public sector chronically understaffed and under-equipped. He also stated that due to the large workload that radiologists incur, this negatively impacts on the training, thus affecting the quality of radiologists throughout the industry. Young radiologists generally move from the public hospitals into private clinics.

Another noted limitation was the constant changes in staff establishments at the various facilities due to entrance and exit of new and old staff, respectively, over the study period. This was a limitation in terms of obtaining accurate numbers of staff at the proposal phase. The researcher over-estimated the number of radiology staff (340 as the estimation); therefore a higher sample size was predicted.

5.8 Conclusion

This chapter has presented the discussion of the results, in keeping with the objectives of the study.

The following chapter concludes the study and provides recommendations made by the researcher in terms of latent tuberculosis infection in radiology staff. These include a complex medical screening program and recommendations with regard to administrative measures at hospitals.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

Globally, the world has faced the TB epidemic with a positive attitude, with most first world countries such as the U.S.A and Britain reducing the burden drastically. Other countries, such as South Africa, however have not come close to meeting targets related to TB incidence in the country. With a large portion of the population infected with HIV, the extent of the TB epidemic is compounded. The high co-infection rate has become a burden to hospitals throughout the country, especially in provinces such as KZN where the highest incidence of TB is noted in the eThekwini District.

HCW's in South Africa are three times more likely to acquire TB than the general population. The average incidence of TB amongst HCW is two percent whereas in the general population it is 0.9 percent. South African HCW's are at risk for TB exposure not only when they care for patients but also when they are exposed to active TB disease within their community settings. The need for a comprehensive TB control program for HCW's by healthcare facilities is fundamental in order to adhere to Occupational Health and Safety Laws. Although effective infection control measures can greatly decrease the risk of nosocomial infections, the risk of TB exposure will always be present.

National conditions such as a weak and inequitable economic system, existing government policies on environmental and social laws, poor health care systems and urbanization are factors that affect the population in general. Proximate factors such as unhealthy behaviours, exposure to an active TB case in the community, immunosuppressive and respiratory diseases, overcrowding and poor ventilation, air pollution and tobacco smoking; as well as age, gender

and genetics are all predisposing factors for acquiring TB. HCW's are exposed to all these factors, due to constant occupational exposure. Community exposure cannot be ruled out in South African HCW's due to the varying socio-economic statuses in most communities. Constant exposure makes HCW's more susceptible to contacting TB due to impaired immunity, therefore categorizing them as a high risk group for TB is understandable.

For effective and efficient control of TB, rapid diagnosis and treatment for patients with active TB is the mainstay of most national TB programs in developing countries. The National TB Programme in South Africa does not use isoniazid prophylaxis in HIV negative individuals. The existing arguments of the use of IPT in high prevalence, low resource settings being of limited value due to continued exposure has been maintained. The researcher also believes that this is neither conducive nor safe in health-care settings in South Africa due to persistent TB exposure. Current LTBI treatment programs requiring that the duration of treatment is maintained for as long as there is exposure, but this is not possible for South African HCW's. However, a reduction of exposure risk should be given high priority. With studies performed in South Africa indicating high levels of occupational TB, the need to reduce TB due to occupational exposure is essential.

This study identified a significantly high incidence of LTBI in radiology staff. The analysis of demographic and occupational factors highlighted increasing age (p =0.005) and alcohol consumption (p = 0.037) (demographic factors) and longer durations of employment in current jobs (p =0.014), higher annual incomes (p = 0.048), current hospitals (p = 0.031) and employment by the KZN DoH (p = 0.009) (occupational factors)as significant variables that are associated with LTBI. The concern of community acquired TB in these radiology staff could not be ruled out due to the general high prevalence of TB in the eThekwini health district of KZN; and was noted as a limitation. The prevalence of active TB

disease amongst radiology staff was also noted in this study through questionnaires provided to 182 radiology staff.

With these findings, the following recommendations can be made to prevent the loss of essential skilled HCW's due to TB infection. The recommendations can be used to monitor not only radiology staff but also all HCW's, despite the level of employment. The implementation of an effective screening guideline into the monitoring of the health statuses of HCW's in the workplace is essential. The primary objective of any screening program is to ensure that active TB disease is detected early, in order to reduce the risk of TB transmission, poor prognoses and to reduce the associated social and economical consequences of the disease. Screening for TB in HCW's should be an integral part of TB control programs. In HCW's, the purpose of screening methods within these programs provides two main purposes: 1) to monitor TB transmission and acquisition among HCW's and; 2) to identify latently infected HCW's.

The secondary objective of identifying latently infected HCW's is essential especially when dealing with individuals living with HIV and identifying household contacts that are younger than five years. Latently infected HCW's can be made aware of their statuses and advised to proceed with caution to prevent reactivation, especially those HCW's that are HIV positive. With fewer skilled staff, the burden of work increases and the overall expenditure due to loss of human resources may be reduced. Undiagnosed active TB in HCW's poses the risk of transmission of MTB to patients, already immunocompromised. This is a shortfall in the fight against TB. The need to diagnose active TB disease at an early stage is critical in the control of TB disease in the country.

6.2 Recommendations

The global epidemic of TB, especially drug-resistant TB, is due to a combination of primary transmission and an acquired resistance. Missed diagnoses result in longer durations of infectiousness of the host. This in turn results in continuous transmission especially in high density settings where overcrowding and inadequate ventilation (either at home or at work) is a problem. Curbing primary transmission of TB will assist in decreasing the overall burden of disease in South Africa. In HCW's the need to implement screening tools into annual medical examinations will assist in detecting undiagnosed active TB disease and assist in monitoring latently infected HCW's. Treating active TB disease reduces the infectiousness of the individual, thus reducing the primary transmission. The following may be considered as recommendations to this study:

- Implement further diagnostic tests into the annual medical screening procedure in order to detect undiagnosed active TB disease; and
- Improve administrative procedures:
    - Improvement of occupational health policies.
    - Infection control guidelines specific to each health care facility and each department should be available.
    - Job-specific training to reduce nosocomial spread.

These are further discussed.

6.2.1 Improved medical screening

HCW's should undergo annual medical surveillance for occupational disease. This would include routine investigations and would involve a questionnaire with a medical examination. Improved screening should include a symptom questionnaire that includes the following questions:

- Have you experienced any of the following symptoms:
    - A productive cough for more than two weeks?
    - Haemoptysis (coughing of blood)?

    - Unexplained weight loss?
    - A fever, chills or night sweats for no known reason?
    - Persistent shortness of breath?
    - Unexplained fatigue?
    - Chest pain?
- Have you had contact with anyone (in the home, at work or in the community) with active TB diseases in the past year?
- Do you have any medical condition (including HIV), or are you taking any medications, which suppress your immune system?

In symptomatic patients, the collection of a sputum specimen for microbiological investigation, chest radiography and blood testing where sputum is inconclusive or clear is essential. Diagnostic investigations for active TB disease should be performed on a regular basis, especially in symptomatic HCW's. Occupation specific management (re-allocate staff to areas with a reduced airborne infection zone and a reduced infectious patient turnover) may be required. HCW's should monitor changes in their health statuses. Figure 13 below, outlines the recommended course of diagnostic investigations that HCW's should follow.

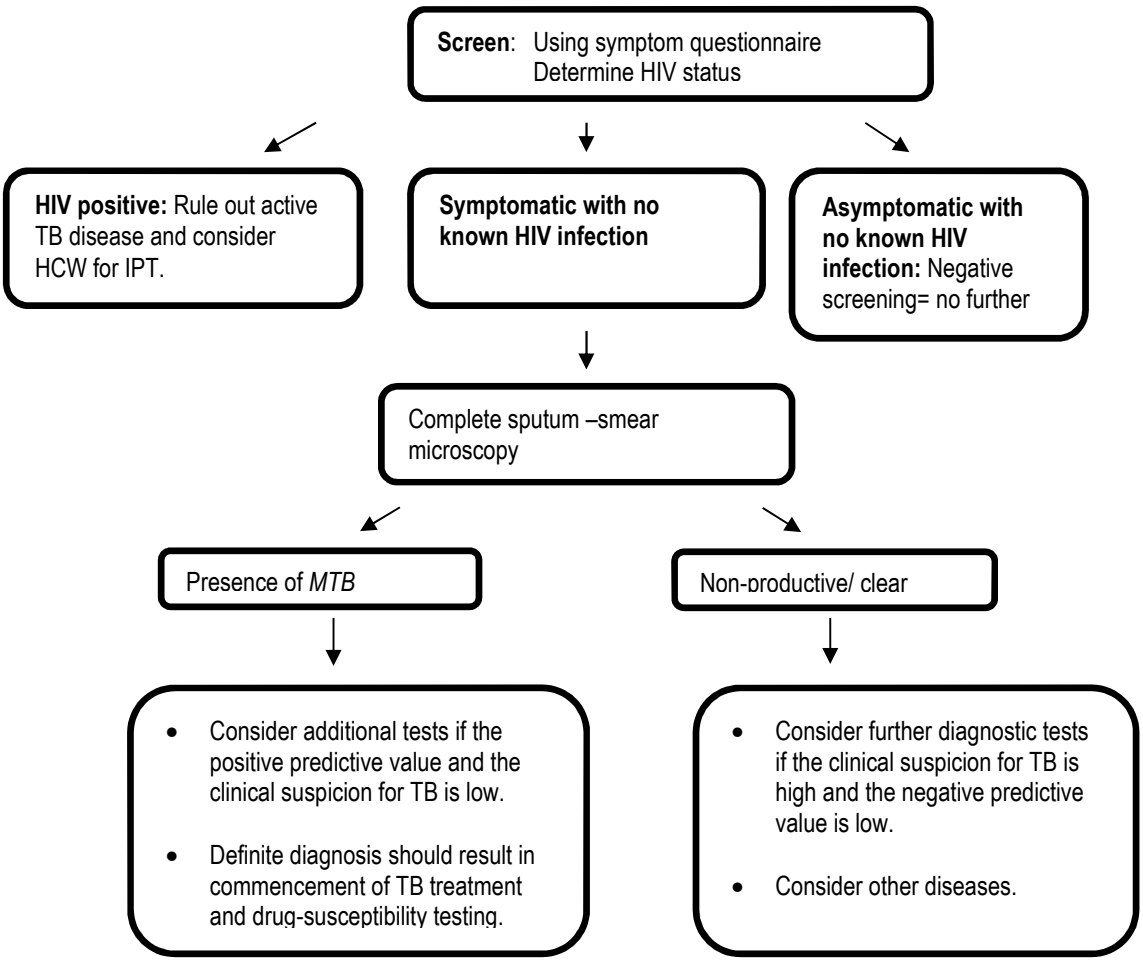

Figure 13: Recommended screening programme for Health Care Workers

As part of the occupational health monitoring plan, all HCW's and staff in a facility, irrespective of risk of exposure or presence of TB signs and symptoms, need to be screened for TB disease. The use of symptom questionnaires and monitoring of body mass are useful cost-effective tools that can be used during the screening process.

The basis of LTBI treatment is ensuring that active TB disease has been ruled out first. Figure 13 displays a screening system that may be used during annual assessment of HCW's or when a HCW attends the occupational health clinic. This system allows for active TB disease to be ruled out, using cost-effective methods, limiting radiological investigations to when they are deemed

necessary. Even though sputum-smear microscopy displays a low sensitivity and the inability to detect drug resistance, most KZN hospitals are not equipped with laboratory equipment for drug susceptibility testing. This type of equipment assists in determining the strain of TB disease, therefore allowing for the correct TB regimen to be used by the patient. South Africa has been the leading country to purchase the Xpert MTB/RIF, therefore the need to reinforce or replace sputum-smear microscopy with the Xpert MTB/RIF method for TB diagnosis is essential. The need to utilize this method is necessary in order to determine the correct strains of TB in a patient and prevent drug-resistant TB.

Once active TB disease is effectively ruled out, only then can LTBI testing be performed on an individual. This however, is only a reality in high resource countries with an overall low burden of TB disease. In these countries, such as the U.S.A, studies have suggested that the HCW's undergo the two-step TST in order to diagnose LTBI. In South Africa, the accepted common policy is to apply chemoprophylaxis only in children and in dual HIV and TB infected patients. However, if we have a more accurate tool to detect LTBI in BCG vaccinated subjects, a national policy of preventive therapy may also include other risk groups, including HCWs. This, however, can only be done when the endemic of active cases of TB has been limited.

6.2.2 Improved administrative procedures

Each facility needs specific administrative controls, consisting of a multi-disciplinary infection control committee, an infection control team and an occupational health screening programme. These will be in compliance with the National Core Standards for Health Establishments in South Africa. The appropriate preventive strategies and staff health monitoring should be improved by changing policies within facilities. Dedicated staff are required to guarantee proper implementation and monitoring of the plan. This can only be effective if understandings of the importance of these policies are delivered to all staff. TB is a known occupational disease in HCWs and the infection rates

have been associated with the occupational category, the duration of employment and the area of work of the HCW. Changes in terms of refocusing priorities from case management to TB transmission reduction should be considered. Suggestions to reduce TB disease rates among young children have been made. Reducing the number of latently infected children entering congregate settings such as schools can result in a decrease of TB transmission to children. Contact investigation would be essential for this to be possible, however resource-limited settings like South Africa may pose a problem. Suggestions to reduce infectious disease in young HCW's may eventually reduce the lifetime risk of TB disease in this population group.

With the emergence of XDR-TB, the need to implement adequate infection-control measures is essential. Simple interventions by use of administrative procedures can allow for the early diagnosis of TB. Policies defining the segregation of infectious TB patients and the continuous education and training of HCWs will be effective. Post tertiary education (at seminars or continuous professional development programs) and in-house training in terms of overall infection control methods is essential to reduce the transmission of *MTB*. This should include hand-washing techniques, the proper disposal of waste and the use of personal protective equipment (including gloves, gowns and masks). Formal training in the use of respirators is recommended to all HCW's regardless of the job title or area of work. The need to educate all HCW's on methods of transmission of diseases is necessary.

Job-specific training should be given to all staff, whether they are directly involved with patients (nursing-clinically), administrative staff or lay-workers. Training should be conducted before initial employment and continued education on infection control should be provided annually to all employees and volunteers. In areas where high risk procedures are a norm, all staff should be trained regularly in order to ensure infection control measures are followed. This allows for both the patient and the HCW to be protected during procedures such

as bronchoscopies, the collection of sputum or sputum induction, chest radiography and or post-mortem procedures. In addition, all staff need to have a general awareness of signs and symptoms, and if present, should approach the occupational health official for TB investigation.

Low-cost measures in South Africa could include engineering controls such as exhaust ventilation or increased natural ventilation or sunlight; and personal protective measures such as the effective use of respirators.

Even though South Africa has made notable progress towards TB control, high rates of LTBI would support the need for the review of and reinforcement of institutional cross-infection measures. This study has identified a significantly high incidence of LTBI in radiology staff, with 86.2 percent of participants testing positive for LTBI. Demographic and occupational associations were made in terms of increasing age, alcohol consumption, longer durations of employment, employment by the KZN DoH and higher annual incomes. These findings reiterate the need for enhanced medical screening methods in radiology staff and other HCW's as well, in order to make early detections of active TB disease. With radiology HCW's in KZN facing numerous hurdles in terms of infection control, high burdens of disease within the community and contact with highly infectious patients, the need for an early diagnosis of TB is critical to their well-being. The early diagnosis and treatment of undetected active tuberculosis disease will assist in reducing the spread of tuberculosis amongst HCW's, thus retaining healthy staff over long-term periods. The impact of infectious staff on the health care system can be substantial; when considering transmission of the disease to co-workers and patients. It is therefore essential to ensure that HCW's are healthy.

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ANNEXURES

Annexure A	Ethical clearance from the Institutional Research Ethics Committee (IREC) of the Durban University of Technology
Annexure Bi	Permission letter from the Department of Health Kwa-Zulu Natal to conduct the study
Annexure Bii	Permission letter from the eThekwini Health District
Annexure Ci	Letter of information and consent – Phase one (English)
Annexure Cii	Letter of information and consent – Phase one (isiZulu)
Annexure Ciii	Letter of information and consent – Phase two (English)
Annexure Civ	Letter of information and consent – Phase two (isiZulu)
Annexure Di	Questionnaire for the radiology Health Care Worker (English)
Annexure Dii	Questionnaire for the radiology Health Care Worker (isiZulu)
Annexure E	Data sheet for TST Administration and Interpretation
Annexure F	TST contraindications
Annexure G	Interpretation of TST according to the CDC standards
Annexure H	Bivariate correlations
Annexure I	Odds ratio estimates of non-reference variables with the status of exclusion or inclusion

Annexure A

DURBAN UNIVERSITY of TECHNOLOGY

INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC)

20 November 2012

IREC Reference Number: **REC 61/12**

Ms S Ackah
101, 113 Beach Road
Amazibu
Amanzimtoti
4126

Dear Ms Ackah

The association of demographics and occupational factors with Latent Tuberculosis Infection in radiology staff at public sector hospitals in the eThekwini Health District

I am pleased to inform you that Full Approval has been granted to your proposal REC 61/12.

The Proposal has been allocated the following Ethical Clearance number **IREC 047/12**. Please use this number in all communication with this office.

Approval has been granted for a period of one year, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's. In addition, you will be responsible to ensure gatekeeper permission.

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

Yours Sincerely

[redacted]

Dr D F Naude
Chairperson: IREC

Annexure Bi

health

Department:
Health
PROVINCE OF KWAZULU-NATAL

Health Research & Knowledge Management sub-component
10 – 103 Natalia Building, 330 Langalibalele Street
Private Bag x9051
Pietermaritzburg
3200
Tel.: 033 – 3953189
Fax.: 033 – 394 3782
Email.: hrkm@kznhealth.gov.za
www.kznhealth.gov.za

Reference : HRKM 015/13
Enquiries : Mr X Xaba
Tel : 033 – 395 2805

Dear Ms S. Ackah

Subject: Approval of a Research Proposal

1. The research proposal titled **'The association of demographics and occupational factors with Latent Tuberculosis Infection (LTBI) in radiology staff in public health hospitals in the eThekwini health district'** was reviewed by the KwaZulu-Natal Department of Health.

   The study is hereby **approved** to be undertaken at Addington, Clairwood, King Edward VIII, Mahatma Gandhi, Osindisweni, Prince Mshiyeni, RK Khan and Wentworth Hospitals.

   NB: No financial and/or human resources will be provided by the Department and Hospitals

2. You are requested to take note of the following:
   a. Make the necessary arrangement with the identified facility before commencing with your research project.
   b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.

3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

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

Yours Sincerely

[redacted]

Dr E Lutge
Chairperson, Health Research Committee
Date: 13/02/2013

Annexure Bii

health

Department:
Health
PROVINCE OF KWAZULU-NATAL

Postal Address: Private Bag X54318 Durban 4000
ss: 83 Jan Smuts Highway, Mayville, Durban 4001
Tel.031 2405308: Fax. 031 2405500
Email. nan.hoosain@kznhealth.gov.za
www.kznhealth.gov.za

Enquiries: Ms Jabu Hlazo
Tel: 031 240 5303
Date: 8 January 2013

Attention: Ms Shiroma Ackah: shiroma.ackah@gmail.com

REQUEST TO CONDUCT RESEARCH:
"The association of demographics and occupational factors with Latent Tuberculosis Infection in Radiology Staff at public sector hospitals in the eThekwini District"

Support is hereby granted to conduct research on the above topic.

Please note the following:

1. Please ensure that you adhere to all the policies, procedures, protocols and guidelines of the Department of Health with regard to this research.
2. This research will only commence once this office has received confirmation from the Provincial Health Research Committee in the KZN Department of Health.
3. Please ensure that this office is informed before you commence your research.
4. The District Office will not provide any resources for this research.
5. You will be expected to provide feedback on your findings to the District Office.

[redacted]

PP District Manager
eThekwini
Telephone: 031 2405303
Fax : 031 2405500
Email: jabulisiwe.hlazo@kznhealth.gov.za

Annexure Ci

INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC)

LETTER OF INFORMATION (PHASE 1)

Thank you for considering participation in Phase 1 of my research study. Your valuable input will help ensure the success of the study.

Title of the Research Study:

The association of demographics and occupational factors with Latent Tuberculosis Infection (LTBI) in radiology staff at public sector hospitals in the eThekwini Health district.

Principal researcher: Shiroma Ackah (B.Tech: Radiography (D))

Supervisor/s: Mrs Lynda Swindon (M.Ed (HE))

Co-supervisor/s: Dr Saloshni Naidoo (PhD)

Brief Introduction and Purpose of the Study:

I am conducting a research project in order to complete a Master of Technology degree in Radiography (Diagnostic) through the Department of Radiography at Durban University of Technology. *The purpose of this study is to investigate the association of demographics and occupational factors with LTBI in radiology staff in public sector hospitals of the eThekwini Health district.* Tuberculosis (TB) is an occupational disease that is well known to all health care workers. TB infection is caused by droplets being released into the air when a person who is infected by TB coughs, speaks, sneezes etc. The human body is able to control the bacterial activity; however, some bacteria survive and remain inactive but alive for many years. This is referred to as LTBI. In cases where the immune system is weakened, LTBI may turn into active TB disease.

Outline of the Procedures:

The study will be conducted in the eThekwini Health District of KwaZulu-Natal in public regional and district hospitals. You are invited to take part in Phase one of this study by completing a questionnaire. The purpose of this letter is to provide you with information and obtain your consent, and willingness to participate in completing the questionnaire. Where necessary, you may be asked to submit a partially completed questionnaire depending on your answers to some of the questions asked. These questions have been asked to prevent any adverse reactions to the test (TST) that will be performed in Phase two. A second consent form will be given to you, if you qualify for the second phase of the study. If you meet the inclusion criteria (these will be explained to you by the researcher) for Phase two, you may then undergo a two-step tuberculin skin test (TST), commonly known as the Mantoux test, for LTBI. The results of this test will be given to you and you will then be advised what to do according to your results.

Risks or Discomforts to the Participant:

The questionnaire will not result in any adverse consequences or embarrassment to you.

Benefits:

Annexure Ci

This study hopes to identify LTBI in radiology staff in the public sector hospitals in the eThekwini Health District. It is hoped that the results from this study will be used to improve staff health, by showing the need for medical screening (during pre-employment and the employment process) because LTB screening in healthcare workers is currently not being carried out in Kwa-Zulu Natal. This study hopes to make recommendations for the use of routine screening for the early detection of LTBI so that early treatment can be given and LTBI can be prevented from becoming active TB disease in radiographers, other radiology staff and hopefully all health care workers. Routine testing will help decrease the rate of active TB disease and so allow for an improved health care system. Therefore, priority must be given to the diagnosis of LTBI in order to prevent active TB disease from developing. The results of this study will be published in a suitable journal.

Reason/s why the Participant May Be Withdrawn from the Study/Self Withdrawal:

If you do not qualify for Phase two of the study you will be taken out of the study after completing the questionnaire. If you continue to Phase two you may be taken out of the study if you suffer any adverse reactions to the TST (This is not expected). You will not be forced or pressurised to participate and you may withdraw from the study at anytime during the research. Nothing will be held against you if you withdraw.

Remuneration:

You will not be paid to participate in the study, however, you may receive a free TST which will diagnosis the presence of LTBI if it exists. The result of this test will be given to you and you will be advised what to do if necessary.

Costs of the Study:

The research is paid for from the researcher's budget. You will not have to pay for the tests (TST).

Confidentiality:

Your name will not appear on any of the data collection forms, however, you will be identified by a code number so that you can be contacted by the researcher who is the only person who will be able to link your name to the number. Your personal and other information will not be divulged to anyone except the researcher and supervisor. Your information will only be used for research purposes. Any information that could identify you will be excluded during data collection so that you remain anonymous.

Research-related Injury:

It is not anticipated that there will be any injuries caused by the study, however if any injury should occur you will be referred for the appropriate medical treatment, but no compensation will be provided. Injuries should be reported to the researcher immediately.

Persons to Contact in the Event of Any Problems or Queries:

Please contact the researcher (Ms Ackah - 0720863686), my supervisor (Mrs Swindon - 0722684355) or the Institutional Research Ethics Committee administrator (Ms Deonarian) on 031 373 2900. DVC TIP (Prof F. Otieno) on 031 3732382 or dvctip@dut.ac.za

Complaints can be reported to the **IREC Administrator:**

Ms L. Deonarain
Durban University of Technology
Contact no: (031) 373 2900
Email: LavishaD@dut.ac.za

Annexure Ci

INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC) - CONSENT (PHASE 1)

Statement of Agreement to Participate in the Research Study:

I hereby confirm that I have been informed by the researcher, _____ (name of researcher), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,

I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.

I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.

In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.

I may, at any stage, without prejudice, withdraw my consent and participation in the study.

I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.

I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

I am aware that this is Phase 1 of the study and I may or may not be included as a participant for Phase 2 depending on my eligibility for the next phase.

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

I, _____ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

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

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

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

Annexure Cii

INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC)

INCWADI YOMBIKO (1)

Ngiyabonga ngokuba nibe inxenye yababambe iqhaza esigabeni sokuqala yesifundo socwaningo lwami. Imibono yenu ebalulekile iyongisiza ekuphumeleleni esifundweni sami.

Isihloko socwaningo:

Ukuxhumana phakathi kwenani labantu endaweni ethile kanye nezinto ezithile emsebenzini abawenzayo wase x-ray negciwane lesifo sofuba elisalele ezisebenzini zezibhedlela zikahulumeni, eThekwini namaphethelo.

Inhloko yocwaningo: Shiroma Ackah (B.Tech: Radiography (D)

Umxhumanisi: Mrs Lynda Swindon (M.Ed (HE)

Umlekeleli kamxhumanisi: Dr Saloshni Naidoo (PhD)

Isingeniso Nenjongo yocwaningo:

Ngenza ucwaningo ukuze ngiqedele iziqu ze Master of Technology kui Radiography (ukuthola isifo), ucwaningo lwami ngilwenza ne Department of Radiography e Durban University of Technology. Injongo yalolu cwaningo ukubheka ubudlelwano phakathi kwenani labantu endaweni nezinto emsebenzini ezingenza umuntu abenesifo sofuba esingaka veli kubasebenzi base x-ray ezibhedlela zikahulumeni eThekwini namaphethelo. Isifo sofuba yisona okujwayelekile ukuthi abasebenzi bezempilo basithole emsebenzini, amagciwane esifo sofuba atholakala emoyeni, uma umuntu enaso ekhwehlela, ekhuluma noma efinya, njalo-njalo. Umzimba womuntu unawo amandla okulwa, negciwane lize lidambe, kodwa elinye igciwane liyaphila lilale lingenzi sifo iminyaka eminingi, lilinde ukuthi umzimba wehlelwe amandla bese lujavuka lenze isifo sofuba.

Indlela ucwaningo oluzohamba ngayo:

Lolucwaningo luzokwenziwa eThekwini namaphethelo esifundeni sakwaZulu- Natal, ezibhedlela zakwa Hulumeni. Uyamenywa ukuba uzibandakanye esigabeni sokuqala socwaningo lokugcwalisa kwemibuzo yesifo sofuba. Lencwadi isho ukuthi wazisiwe wavuma ukuzibandakanya ukuba ube ingxenye yabaphendula imibuzo. Uma kunesidindingo uyocelwa ukuba ulethe ingxenye yemibuzo engcwaliswe, koyangokuthi imibuzo ithini. Lemibuzo ibuzelwa ukugcina indlela yokuphepha nokuvikela noma isipho isehlakalo esingenzeka esigabeni sesibili kuTST (Tuberkulin Skin Test). Ifomu yesivumelwane sesibili ingagcwaliswa umuntu okhethiwe ocwaningeni lwesigaba sesibili. Uma bephumelela endleleni esetshenzisiwe ukukhethela ucwaningo, abazibandakanyayo bangase behlengabe zene nokuhlolwa okubizwa ngokuthi u two-step TST indlela yesibili yokuhlolwa isifo se TB esikhumbeni evamiswe ukubizwe ngokuthi isivivinyo i-mantoux ye LTBI (lokhu kuzochazwa umcwaningi) imiphumela yalesivivinyo uyonikezwa yona futhi uyolulkwa ngedlela.

Ubungozi nokungaphatheki kahle kwaba hlanganyeli:

Imibuzo yocwaningo ayenzelwanga ukucwasa noma ukuhlaza abaphendula imibuzo. Bonke abazindakanyayo bayovikelwa amalungelo abo.

uBuhle balolucwaningo:

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Lolucwaningo luhlose ukuthola ukuthi kujwayeleke kangakanani kubasebenzi base x-ray ezibhedlela zikahulumeni eThekwini namaphethelo, ukutholakala kwegciwane lisalele lesifo sofuba. Imiphumela ihlose ukuthuthukisa ezempilo ngokuthola izinto ezingenziwa uma kufanele kuhlolwe umuntu uma esazoqashwa emsebenzini ukuthi uphila kanjani, ukuze kuthi uma seku-qhutshekwa nokumhlola eseqashiwe zaziwe izifo aqashwe engenazo, KwaZulu Natal abasebenzi bezempilo abahlolelwa isifo sofuba singakaveli. Lolucwaningo luzophakamisa ukuthi kwenziwe uhlelo lokuhlola abasazoqashwa nabasebenzi njalo, ukuze kusheshe kutholakale isifo sofuba umuntu engakabi nazimpawu, lokho kuzosiza ukuthi basheshe, imithi ezovikela kubasebenzi base x-ray, nabobonke abasebenzi bezempilo. Lokhu kuhlolwa kuzokwehlisa izinga lesifo sofuba futhi lwenze ngcono impilo ezisebenzini zezempilo. Ngakho-ke kuzobaluleka ukutholakala kwaleli gciwane elenza isifo sofuba lisalele lingaze livuke bese lenza isifo sofuba. Imiphumela izoshicilelwa emaphepha ndabeni, angaphakathi kwezempilo ukuze afundwe abanye abasebenzi bezempilo.

Izizathu ezingenza abanye bayekiswe noma baziyekele ukuhlanganyela kulolucwaningo:

Ungayekiswa uma kutholakala ukuthi awusahlangani nezidingo zocwaningo noma ukuhlolwa akukuphathanga kahle emzimbeni akekho ongakuphoqa ukuqhubeka nokuhlanganyela, uma ungasathandi nanoma yinini akukho okubi okungenziwa uma uziyekela.

Inkokhelo:

Akukho mali ozoyithola, noma uhlobo luni lwenkokhelo, ngokuhlanganyela kulolucwaningo. Uzothola ukuhlolwa mahala, ukuze kusheshe kutholakale ukuthi unalo yini leligciwane lesifuba elisalele. Imiphumela uyokwaziswa yona bese uthola ukwelulekwa ngokufanele imiphumela yakho.

Izindleko Zocwaningo:

Akukho zindleko ozozikhokha ngoba kunemali ebhekelela ucwaningo ebekwa eceleni.

Ukugcinwa kwemfihlo:

Kuzosetshenziswa izinombolo ezithile ukuze uncwaningo lugcineke luyimfihlo kungaveli gama lamuntu. Akukho muntu ozokwazi ngawe ngaphandle komcwaningi nomphathi wakhe. Ukuze kufezeke injongo yocwaningo, kuzodingeka izinto ezincikene nocwaningo kuphela, ezithinta izindaba zakho ngeke zithathwe ukuze kuqinisekise imifihlo.

uBungozi obuncikene nocwaningo:

Abukho ubungozi obuncikene nocwaningo kodwa uma kungenzeka uyothola ukwelashwa, akukho sinxephezelo oyosithola.

Abantu ongabathinta uma kunenkinga noma imibuzo:

Thinta umcwaningi (Ms Ackah - 0720863686), umphathi (Mrs Swindon - 0722684355) noma Institutional Research Ethics Committee administrator (Ms Deonarian - 031 373 2900). DVC TIP (Prof F. Otieno) on 031 3732382 or dvctip@dut.ac.za

Izikhalo ungazibika kwi **IREC Administrator :**

Ms L. Deonarain
Durban University of Technology
Contact no: (031) 373 2900
Email: LavishaD@dut.ac.za

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INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC)

IMVUME (1)

Imvume yokuba yingxenye yocwaningo:

Ngiyavuma ukuthi ngichazelwe ngumcwaningi, _____ (Igama lomcwaningi),ngalokhu okulandelayo, uhlobo locwaningo, indlela yokuziphatha, ubuhle nobungozi obungaba khona –Inombolo yocwaningo: _____,

Ngithole incwadi (yokungazisa njengo mhlanganyeli) mayelana nocwaningo, ngayifunda ngayizwa kahle.

Ngiyazi ukuthi imiphumela yocwaningo nezinto ezithinta mina njengalezi ezilandelayo. Iminyaka, ubulili, usuku lokuzalwa usuku lokuzalwa, amagama ami ngokufingqiwe nesifo sami akuzuvezwa uma sekubhaliwe ngocwaningo.

Ngiyavumelana nokuthi konke abakutholile kimi bakufake kwi Computer njengokwesidingo.

Kunoma isiphi isigaba socwaningo, ngiyazi ukuthi ngivumelekile ukukhansela imvume yami kanye nokuzimbandakanya nocwaningo.

Ngithole ithuba elanele ukubuza imibuzo ngakho-ke ngokungaphoqwa muntu, ngizimisele ukuzimbandakanya nocwaningo.

Ngiyazi ukuthi konke okusha okuzo tholakala kulolucwaningo ngizokwaziswa ngalo.

_____ _____ _____ _____

Amagama aphelele omuntu

ozimbandanye ocwaningweni **Usuku** **Isikhathi** **Signature / Right Thumbprint**

Mina, _____ (Igama lomcwaningi) ngiyaqinisa ukuthi lona ozohlanganyela ocwaningweni utshelwe konke ngalokhu okulandelayo uhlobo locwaningo, indlela yokuziphatha ngesikhathi socwaningo kanye nobungozi okungenzeka bubekhona kulolucwaningo.

_____ _____ _____

Amagama aphelele omcwaningi **Usuku** **Signature**

_____ _____ _____

Amagama aphelele ofakazi (If applicable) **Usuku** **Signature**

_____ _____ _____

Amagama aphelele uLegal Guardian **Usuku** **Signature**

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INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC)

LETTER OF INFORMATION (PHASE 2)

Thank you for completing Phase 1 of my research study. You have now qualified to continue into Phase 2 of the study as detailed below. Your participation is greatly appreciated and will provide valuable information for my study.

Title of the Research Study:

The association of demographics and occupational factors with Latent Tuberculosis Infection (LTBI) in radiology staff at public sector hospitals in the eThekwini Health district.

Principal researcher: Shiroma Ackah (B.Tech: Radiography (D))

Supervisor/s: Mrs Lynda Swindon (M.Ed (HE))

Co-supervisor/s: Dr Saloshni Naidoo (PhD)

Brief Introduction and Purpose of the Study:

I am conducting a research project in order to complete a Master of Technology degree in Radiography (Diagnostic) through the Department of Radiography at Durban University of Technology. *The purpose of this study is to investigate the association of demographics and occupational factors with Latent Tuberculosis Infection in radiology staff in public sector hospitals of the eThekwini Health district*. Tuberculosis (TB) is an occupational disease that is well known to all health care workers. TB infection is caused by droplets being released into the air when a person who is infected by TB coughs, speaks, sneezes etc. The human body is able to control the bacterial activity; however, some bacteria survive and remain inactive but alive for many years. This is referred to as LTBI. In cases where the immune system is weakened, LTBI may turn into active TB disease.

Outline of the Procedures:

The study will be conducted in the eThekwini Health District of KwaZulu-Natal in public regional and district hospitals. You are now invited to take part in Phase two of the study. You have already completed a detailed questionnaire that required information with regard to your personal and medical health, as well as occupational and demographic information. As a result of their responses to some of the questions, some participants have been excluded from continuing with the study. You, however, have been selected to continue with the study as you do not have any conditions that would prevent you from continuing to Phase 2. You will now undergo a two-step tuberculin skin test (TST), which is commonly known as the Mantoux test, for LTBI. In the two-step method some participants will need a second TST, depending on their first TST result to make sure that the diagnosis of LTBI is correct (This will be explained to you in detail by the researcher). The outcome and interpretation of the TST will be given to you and if your result is positive you will be advised as to further treatment and follow-ups, outside of this research study.

Risks or Discomforts to the Participant:

The TST involves administration of a drug into the front part of your forearm using a needle. A slight discomfort may be experienced apart from the prick of the needle such as redness, swelling or itchiness. This must be reported to the researcher as soon as they occur (see researcher's details below). The TST is an FDA approved testing method and has been used for over a century for LTBI diagnosis. It is considered to be safe and no side effects are expected.

Benefits:

This study hopes to identify LTBI in radiology staff in the public sector hospitals in the eThekwini Health District. It is hoped that the results from this study will be used to improve staff health, by showing the need for medical screening (during pre-employment and the employment process) because LTB screening in healthcare workers is currently not performed in Kwa-Zulu Natal. This study hopes to make recommendations for the use of routine screening for the early detection of LTBI so that early treatment can be given and LTBI can be prevented from becoming active TB disease in radiographers, other radiology staff and hopefully all health care workers. Routine testing will help decrease the rate of active TB disease and also allow for an improved health care system. Therefore, priority must be given to the diagnosis of LTBI in order to prevent active TB disease from developing. The results of this study will be published in a suitable journal.

Reason/s why the Participant May Be Withdrawn from the Study/Self Withdrawal:

If for some reason during Phase 2 you no longer qualify or if you suffer any adverse reactions to the TST (this is not expected) you will be withdrawn from the study. You will not be forced or pressured to participate and you may withdraw from the study at anytime during the research. Nothing will be held against you if you withdraw.

Remuneration:

You will not be made to participate in the study, however, you may receive a free TST which will diagnose the presence of LTBI if it exists. The result of this test will be given to you and you will be advised what to do if your results happen to be positive.

Costs of the Study:

The research is paid for by the researcher's budget. You will not have to pay for any tests (TST).

Confidentiality:

Your name will not appear on any of the data collection forms, however you will be identified by a number code so that you can be contacted by the researcher who is the only person who will be able to link your name to the number. Your personal or other information will not be divulged to anyone except the researcher and supervisor. Your information will only be used for research purposes. Any information that could identify you will be excluded during data collection so that you remain anonymous.

Research-related Injury:

It is not anticipated that there will be any injuries caused by the study, however if any injury should occur you will be referred for the appropriate medical treatment, but no compensation will be provided. Injuries should be reported to the researcher immediately.

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Persons to Contact in the Event of Any Problems or Queries:

Please contact the researcher (Ms Ackah - 0720863686), my supervisor (Mrs Swindon - 0722684355) or the Institutional Research Ethics Committee administrator (Ms Deonarian) on 031 373 2900. DVC TIP (Prof F. Otieno) on 031 3732382 or dvctip@dut.ac.za

Complaints can be reported to the **IREC Administrator** **:** Ms L. Deonarain
Durban University of Technology
Contact no: (031) 373 2900
Email: LavishaD@dut.ac.za

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INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC) - CONSENT (PHASE 2)

Statement of Agreement to Participate in the Research Study:

I hereby confirm that I have been informed by the researcher, _____ (name of researcher), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,

I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.

I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.

In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.

I may, at any stage, without prejudice, withdraw my consent and participation in the study.

I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.

I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

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

I, _____ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

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

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INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC)

INCWADI YOMBIKO 2

Ngiyabonga kakhulu ngokuqeda isigaba sokuqala socwaningo lwami. Ngalokho senidlulele esigabeni sesibile socwaningo njengoba kuchaziwe ngezansi.

Isihloko socwaningo:

Ukuxhumana phakathi kwenani labantu endaweni ethile kanye nezinto ezithile emsebenzini abawenzayo wase x-ray ne gciwane sesifo sofuba elisalele, Esisebenzini zezibhedlela zikahulumeni, eThekwini namaphethelo.

Inhloko yocwaningo: Shiroma Ackah (B.Tech: Radiography (D))

Umxhumanisi: Mrs Lynda Swindon (M.Ed (HE))

Umlekeleli kamxhumanisi: Dr Saloshni Naidoo (PhD)

Isingeniso Nenjongo yocwaningo:

Ngenza ucwaningo ukuze ngiqedele iziqu ze Master of Technology kui Radiography (ukuthola isifo), ucwaningo lwami ngilwenza ne Department of Radiography e Durban University of Technology. Injongo yalolu cwaningo ukubheka ubudlelwano phakathi kwenani labantu endaweni nezinto emsebenzini ezingenza umuntu abenesifo sofuba esingaka veli kubasebenzi base x-ray ezibhedlela zikahulumeni eThekwini namaphethelo. Isifo sofuba yisona okujwayelekile ukuthi abasebenzi bezempilo basithole emsebenzini, amagciwane esifo sofuba atholakala emoyeni, uma umuntu enaso ekhwehlela, ekhuluma noma efinya, njalo-njalo. Umzimba womuntu unawo amandla okulwa, negciwane lize lidambe, kodwa elinye igciwane liyaphila lilale lingenzi sifo iminyaka eminingi, lilinde ukuthi umzimba wehlelwe amandla bese lujavuka lenze isifo sofuba.

Indlela ucwaningo oluzohamba ngayo:

Lolucwaningo luzokwenziwa eThekwini namaphethelo esifundeni sakwaZulu- Natal, ezibhedlela zakwa Hulumeni, uyacelwa ukuba ngomunye ozohlanganyela esigabeni sesibili salolucwaningo, uma usugcwalise yonke imininingwane ngalokhu okulandelayo ngobuwena, umlando wakho wezempilo, nomsebenzi wakho owenzayo. Abanye bakhishiwe abasezuhlanganyela kulolucwaningo, ngenxa yobungozi obubonakele. Wena ungomunye wabazoqhubeka uhlolelwe isifo sofuba. Kuzodingeka uhlolwe kabili ukuze kube nesiqiniseko sokuthi imiphumela yesifo sofuba awunaso. Uzokwaziswa ngemiphumela uma kutholakale ukuthi unesifo sofuba, uyo-kwaziswa ngokuzoqhubeka njengokuthi, imithi yokwelashwa uzoyilanda kuphi nokuthi uzobuya nini ukuzohlolwa futhi, lokho kuzokwenzeka ngaphandle kocwaningo.

Ubungozi nokungaphatheki kahle kwaba hlanganyeli:

Uzojovwa engalweni. Bukhona obunye ubungozi obuncane obungenzeka kanye nokungaphatheki kahle.

Angaba mancane amathuba okuthi kube khona ukubabomvu; okuvuvukala nokubaba okungatholakala endaweni yokujova or yokujovela. Uma lokhu kuqhubeka noma kwenzeka kumele kubikwe KiMcubunguli ngokushesha kungakapheli maseko. (Ngemininingwano yoMcubunguli ungafunda ngezanzi)

uBuhle balolucwaningo:

Annexure Civ

Lolucwaningo luhlose ukuthola ukuthi kujwayeleke kangakanani kubasebenzi base x-ray ezibhedlela zikahulumeni eThekwini namaphethelo, ukutholakala kwegciwane lisalele lesifo sofuba. Imiphumela ihlose ukuthuthukisa ezempilo ngokuthola izinto ezingenziwa uma kufanele kuhlolwe umuntu uma esazoqashwa emsebenzini ukuthi uphila kanjani, ukuze kuthi uma seku-qhutshekwa nokumhlola eseqashiwe zaziwe izifo aqashwe engenazo, KwaZulu Natal abasebenzi bezempilo abahlolelwa isifo sofuba singakaveli. Lolucwaningo luzophakamisa ukuthi kwenziwe uhlelo lokuhlola abasazoqashwa nabasebenzi njalo, ukuze kusheshe kutholakale isifo sofuba umuntu engakabi nazimpawu, lokho kuzosiza ukuthi basheshe, imithi ezovikela kubasebenzi base x-ray, nabobonke abasebenzi bezempilo. Lokhu kuhlolwa kuzokwehlisa izinga lesifo sofuba futhi lwenze ngcono impilo ezisebenzini zezempilo. Ngakho-ke kuzobaluleka ukutholakala kwaleli gciwane elenza isifo sofuba lisalele lingaze livuke bese lenza isifo sofuba. Imiphumela izoshicilelwa emaphepha ndabeni, angaphakathi kwezempilo ukuze afundwe abanye abasebenzi bezempilo.

Izizathu ezingenza abanye bayekiswe noma baziyekele ukuhlanganyela kulolucwaningo:

Ungayekiswa uma kutholakala ukuthi awusahlangani nezidingo zocwaningo noma ukuhlolwa akukuphathanga kahle emzimbeni akekho ongakuphoqa ukuqhubeka nokuhlanganyela, uma ungasathandi nanoma yinini akukho okubi okungenziwa uma uziyekela.

Inkokhelo:

Akukho mali oziyithola, noma uhlobo luni lwenkokhelo, ngokuhlanganyela kulolucwaningo. Uzothola ukuhlolwa mahala, ukuze kusheshe kutholakale ukuthi unalo yini leligciwane lesifuba elisalele. Imiphumela uyokwaziswa yona bese uthola ukwelulekwa ngokufanele imiphumela yakho.

Izindleko Zocwaningo:

Akukho zindleko ozozikhokha ngoba kunemali ebhekelela ucwaningo ebekwa eceleni.

Ukugcinwa kwemfihlo:

Kuzosetshenziswa izinombolo ezithile ukuze uncwaningo lugcineke luyimfihlo kungaveli gama lamuntu. Akukho muntu ozokwazi ngawe ngaphandle komcwaningi nomphathi wakhe. Ukuze kufezeke injongo yocwaningo, kuzodingeka izinto ezincikene nocwaningo kuphela, ezithinta izindaba zakho ngeke zithathwe ukuze kuqinisekise imifihlo.

uBungozi obuncikene nocwaningo:

Abukho ubungozi obuncikene nocwaningo kodwa uma kungenzeka uyothola ukwelashwa, akukho sinxephezelo oyosithola.

Abantu ongabathinta uma kunenkinga noma imibuzo:

Thinta umcwaningi (Ms Ackah - 0720863686), umphathi (Mrs Swindon - 0722684355) noma Institutional Research Ethics Committee administrator (Ms Deonarian - 031 373 2900). DVC TIP (Prof F. Otieno) on 031 3732382 or dvctip@dut.ac.za

Izikhalo ungazibika kwi **IREC Administrator :** Ms L. Deonarain

Durban University of Technology
Contact no: (031) 373 2900
Email: LavishaD@dut.ac.za

Annexure Civ

INSTITUTIONAL RESEARCH ETHICS COMMITTEE (IREC)

IMVUME (2)

Imvume yokuba yingxenye yocwaningo:

Ngiyavuma ukuthi ngichazelwe ngumcwaningi, _____ (Igama lomcwaningi),ngalokhu okulandelayo, uhlobo locwaningo, indlela yokuziphatha, ubuhle nobungozi obungaba khona –Inombolo yocwaningo: _____,

Ngithole incwadi (yokungazisa njengo mhlanganyeli) mayelana nocwaningo, ngayifunda ngayizwa kahle.

Ngiyazi ukuthi imiphumela yocwaningo nezinto ezithinta mina njengalezi ezilandelayo. Iminyaka, ubulili, usuku lokuzalwa usuku lokuzalwa, amagama ami ngokufingqiwe nesifo sami akuzuvezwa uma sekubhaliwe ngocwaningo.

Ngiyavumelana nokuthi konke abakutholile kimi bakufake kwi Computer njengokwesidingo.

Kunoma isiphi isigaba socwaningo, ngiyazi ukuthi ngivumelekile ukukhansela imvume yami kanye nokuzimbandakanya nocwaningo.

Ngithole ithuba elanele ukubuza imibuzo ngakho-ke ngokungaphoqwa muntu, ngizimisele ukuzimbandakanya nocwaningo.
Ngiyazi ukuthi konke okusha okuzo tholakala kulolucwaningo ngizokwaziswa ngalo.

_____	_____	_____	_____
Amagama aphelele omuntu ozimbandanye ocwaningweni	**Usuku**	**Isikhathi**	**Signature / Right Thumbprint**

Mina, _____ (Igama lomcwaningi) ngiyaqinisa ukuthi lona ozohlanganyela ocwaningweni utshelwe konke ngalokhu okulandelayo uhlobo locwaningo, indlela yokuziphatha ngesikhathi socwaningo kanye nobungozi okungenzeka bubekhona kulolucwaningo.

_____	_____	_____
Amagama aphelele omcwaningi	**Usuku**	**Signature**
_____	_____	_____
Amagama aphelele ofakazi (If applicable)	**Usuku**	**Signature**
_____	_____	_____
Amagama aphelele uLegal Guardian	**Usuku**	**Signature**

Annexure Di

QUESTIONNAIRE FOR THE RADIOLOGY HEALTH CARE WORKER

Dear Participant

Thank you for agreeing to participate in my study. Please note that your identity and answers will be kept confidential and will not be divulged to anyone. This study aims to examine the association of demographics and occupational factors with Latent Tuberculosis Infection (LTBI) in radiology staff in public sector hospitals of the eThekwini Health District. A study of this nature will provide important information with regard to occupational health and the medical screening process of radiology health care workers, primarily for TB screening.

Instructions: Please complete the following questions as accurately as you can.
Read each question carefully and answer as honestly as possible.
In areas where boxes ( ) are allocated, tick the appropriate box.
Questions with more than one option will be specified.
If there are any questions that you do not understand, please feel free to ask the researcher.

DEMOGRAPHIC DETAILS

Study Subject Number		_____			
Date of Interview		_____			
Health Facility		_____			
1.1	Age	_____			
1.2	Have you ever been diagnosed with TB?	Yes	1	No	0
1.3	What type of TB have you been diagnosed with?				
	pulmonary	Yes	1	No	0
	extra-pulmonary	Yes	1	No	0
1.4	Have you ever been treated for TB?	Yes	1	No	0
1.5	Are you currently being treated for TB?	Yes	1	No	0

Please Note:
If you have answered **YES** to any of the above questions, you do not need to continue with completing the questionnaire as you do not qualify for the Tuberculin Skin Test (TST). The questions listed above are to any prevent you from experiencing any adverse reactions to the TST. The information you have provided thus far will be considered as confidential and be treated with extreme respect. Your name and details will not be divulged to anyone. You are required to please submit the entire questionnaire, even though incomplete, in order for the researcher to protect your confidential information. If you have any questions with regard to your exclusion from the study, please feel free to ask the researcher. Thank you for your co-operation and willingness to participate in my study.

Annexure Di

1.6 Sex M 0 F 1

1.7 Race

African	1	Coloured	2	Indian	3	White	4	Other	5

1.8 Place of Birth? Republic of South Africa 1 Other 0

1.9. Marital Status Married Single Divorced Widowed

1.10. What is the highest academic qualification?
Less than a matric
Matric
Certificate
National Diploma
Undergraduate Degree
Postgraduate Degree

EMPLOYMENT DETAILS AND HISTORY

1.11 What is your current job title?

Diagnostic Radiographer	5
General assistant/ Porter	4
Administrator	3
Manager/ Assistant Manager	2
Radiologist/Registrar	1
Darkroom Operator	0

Other
If other: Please specify: _____

1.12 How long have you been employed in your current job? _____

1.13 How long have you worked at this specific hospital? _____

1.14 How long have you been employed by the KZN Department of Health? _____

1.15 Are you in contact with individuals suspected of TB on the following basis? **Choose one.**
Daily Weekly
Monthly Do not know

1.16 If on a daily basis tell us on average how many hours do you spend with individuals suspected of TB? _____

1.17 Are you in contact with a confirmed TB patient on the following basis? **Choose one.**
Daily Weekly

Monthly Do not know

1.18 If on a daily basis tell us on average how many hours do you spend with TB cases?

_____

1.19 Have any of your co-workers been diagnosed with TB in the past? Yes 1 No 0

1.20 If answered yes to above, how many co-workers do you know of that have been diagnosed with TB? _____

1.21 If Yes to 1.19, when were they diagnosed? In the past _____

Week Month
Year Do not know

1.22 With respect to your current job are you provided with PPE (Personal Protective Equipment)? Yes 1 No 0

1.23 Do you wear the PPE provided? Yes 1 No 0

1.24 See attached page for question 1.24

1.25 Have you previously been employed elsewhere? Yes 1 No 0

1.26 With respect to each of your previous jobs ever held please complete the information below:

Job	Duration in Years	Employer	Job Title	TB Exposure (Y/N)	PPE Provided (Y/N)	Dust or Solvent Exposure (Y/N)	If yes, what dust/ solvent
1.							
2.							
3.							
4.							
5.							
6.							

1.27 Do you leave your department during working hours? Yes 1 No 0

1.28 If you answered yes to 1.27, tell us on average how long you spend away from this radiology department during working hours? _____

1.29 Does your department have an air-conditioning system in place? Yes 1 No 0

1.30 Is the air-conditioning system a central system that provides cooling to the entire department?

Yes 1 No 0 □ Do not know

1.31 Does the system provide cooling to a specific area only?

Yes 1 No 0 □Do not know

1.32 If you answered yes to 1.31, specify which area this is? _____

1.33 Does the air-conditioning system function optimally? Yes 1 No 0

1.34 If you have answered No for 1.29 and 1.33, does your department utilize natural ventilation methods (the use of many open windows and doors)? Yes 1 No 0

1.35 If you have answered No for 1.34, does your department have exhaust fans?

Yes 1 No 0

MEDICAL DETAILS

1.36 Would you say that generally your health is?

Poor	1	Fair	2	Good	3
Very good	4	Excellent	5		

Annexure Di

1.37 With respect to your respiratory health answer the following questions: **Tick appropriately**

A. Have you ever been told by a Doctor that you have asthma?	Yes 1	No 0
A. Do you still have it?	Yes 1	No 0
A. At what age were you 1st told about the asthma?	Yrs	
A. If you no longer have it at what age did it stop?		
B.1Have you ever been told by a doctor that you have heart failure?	Yes 1	No 0
B.2 How old were you when you were 1st told about this condition?	Yrs	
C1 Have you ever been told by a Doctor that you have chronic bronchitis?	Yes 1	No 0
C2. Do you still have it?	Yes 1	No 0
C3. At what age were you 1st told about the chronic bronchitis?	Yrs	
C4. If you no longer have it at what age did it stop?	Yrs	
D1. Have you ever been told by a Doctor that you have pneumonia?	Yes 1	No 0
D2. Do you still have it?	Yes 1	No 0
D3. At what age were you 1st told about the pneumonia?	Yrs	
D4. If you no longer have it at what age did it stop	Yrs	
E1. Have you ever been told by a Doctor that you have emphysema	Yes 1	No 0
E2. Do you still have it?	Yes 1	No 0
E3. At what age were you 1st told about the emphysema	Yrs	
E4. If you no longer have it at what age did it stop	Yrs	
F1. Have you ever been told by a Doctor that you have hay fever	Yes 1	No 0
F2. Do you still have it?	Yes 1	No 0
F3. At what age were you 1st told about the hay fever?	Yrs	
F4. If you no longer have it at what age did it stop?	yrs	
G1. Have you had any chest injuries	Yes 1	No 0
G2. If yes specify		
H1. Have you had any chest surgery	Yes 1	No 0

1.38 Do you have any of the following symptoms?

Night sweats	Yes 1	No 0
Weight loss	Yes 1	No 0
Cough for more than two weeks	Yes 1	No 0
Coughing of blood (haemoptysis)	Yes 1	No 0
Fever	Yes 1	No 0

1.39 Have you ever been tested for HIV? Yes 1 No 0

1.40 If answered yes above would you like to share you result with us?
Yes 1 No 0

1.41 What was the result - (Optional) - This will be kept strictly confidential
_____

1.42 Do you have any other illnesses? Yes 1 No 0

1.43 If answered yes in 1.42 then fill in the information on the table below:

Illness	Age of 1st diagnosis	Diagnosed by Doctor	Current Treatment
Diabetes		Yes 1 No 0	
Hypertension		Yes 1 No 0	
Cancer		Yes 1 No 0	
Eczema		Yes 1 No 0	
Other:			

1.44 Have you lost more than 5 kilograms of weight in the past month? Yes 1 No 0

1.45 Have you clothes become too big for you due to a loss of weight? Yes 1 No 0

1.46 In the last 3 months have you had diarrhoea which has lasted for 3 days or more?
Yes 1 No 0

1.47 In the last three months have you had fever for more than 1 month at a time?
Yes 1 No 0

1.48 Have you had white sores in your mouth over the last 3 months? Yes 1 No 0

1.49 Do you have swollen lymph nodes in your neck, under arms or groin? Yes 1 No 0

1.50 Have you ever had shingles in the past 12 months? Yes 1 No 0
1.51 Have you had a severe viral infection in the past month? Yes 1 No 0

1.52 If yes to 1.51, list below:

Name of Infection	Treatment Prescribed	List of Medication taken

1.53 Have you had a BCG vaccine (commonly leaving a scar on the arm) at birth?
Yes 1 No 0

1.54 Have you had immunisation with a vaccine or live virus in the past month?
Yes 1 No 0

1.55 If answered yes to 1.54, please list?

Name of vaccine or live virus	Date administered (approximate date if unsure)

1.56 Are you currently taking any medication? Yes 1 No 0

1.57 If answered yes for 1.56, then fill in the information on the table below?

Name of Medication	**Dosage**	**Age when started**	**Prescribed by Doctor**	
			Yes	**No**

SOCIAL HISTORY

1.58 Do you smoke cigarettes? Yes 1 No 0

1.59 If answered yes above then answer the following questions:

A. How old were you when you 1st started smoking cigarettes	Yrs	
B. Have you smoked at least 100 cigarettes in your life time	Yes 1	No 0
C. About how many cigarettes do you smoke per day		
D. For approximately how many years have you smoked this amount		
E. Have you ever quite smoking for a period of 1 year or more	Yes 1	No 0
F. Have you ever tried to reduce the amount of cigarettes that you smoke	Yes 1	No 0
G. Prior to reducing the number of cigarettes that you smoked daily, how many did you smoke per day		

1.60 Have you ever smoked a pipe regularly? Yes 1 No 0

1.61 If answered yes above then answer the following questions:

A. How old were you when you 1st started smoking the pipe	Yrs	
B. About how many grams of tobacco do you smoke per day		
D. For approximately how many years have you smoked this amount		
E. Have you ever quite smoking a pipe for a period of 1 year or more	Yes 1	No 0
F. Have you ever tried to reduce the amount of tobacco that you smoke	Yes 1	No 0

1.62 Have you ever smoked cigars regularly? Yes 1 No 0

1.63 If answered yes above then answer the following questions:

A. How old were you when you 1st started smoking cigars	yrs	
B. Have you smoked at least 100 cigars in your life time	Yes 1	No 0
C. About how many cigars do you smoke per day		
D. For approximately how many years have you smoked this amount		
E. Have you ever quite smoking cigars for a period of 1 year or more	Yes 1	No 0
F. Have you ever tried to reduce the amount of cigars that you smoke	Yes 1	No 0
G. Prior to reducing the number of cigars that you smoked daily, how many did you smoke per day		

1.64 Do you drink alcohol? Yes 1 No 0

1.65 Do people criticise you for drinking alcohol? Yes 1 No 0

1.66 Do you get angry when people criticise your drinking of alcohol? Yes 1 No 0

1.67 Do you feel guilty about drinking alcohol Yes 1 No 0

1.68 Do you ever need a drink alcohol early in the morning Yes 1 No 0

HOME & FAMILY HISTORY

1.69 Which best describes the type of building in which you live?

urban formal housing	Yes 1	No 0
urban informal housing	Yes 1	No 0
hostel housing	Yes 1	No 0
squatter housing	Yes 1	No 0
rural housing	Yes 1	No 0

1.70 How many people live in your home? _____

1.71 How many people do you share a bedroom with? _____

1.72 Does your home have electricity? Yes 1 No 0

1.73 Are you the sole bread winner of your family? Yes 1 No 0

1.74 If you answered no to above, how many other people at your home are employed? _____.

1.75 What is your annual income? _____

1.76 Does your home have natural ventilation? Yes 1 No 0

1.77 How many windows are there in your home? _____

1.78 Does your home have any of the following:

Central heating	Yes 1	No 0
Ducted air heating	Yes 1	No 0
Air conditioning	Yes 1	No 0

1.79 What source of power do you use?

Electricity	Yes 1	No 0
Gas	Yes 1	No 0
Wood	Yes 1	No 0
Paraffin	Yes 1	No 0
Solar	Yes 1	No 0

1.80 Have any of your family members been diagnosed with TB? Yes 1 No 0

1.81 If answered yes fill in the information in the table below for each time that a family member had TB.

Annexure Di

Relationship to you	Year of Diagnosis	Type of TB	Duration of Treatment	Treatment Outcome	Do they live with you Yes=1 No =0

A sincere thank you to you for participating in my study. Your input and valuable contribution to this study is highly appreciated. The above information will contribute towards statistics relating to demographic and occupational factors associated with Latent TB Infection in radiology staff.

*Adapted from a medical study done by Dr. S. Naidoo and associates, 2012, Department of Occupational Health and Infection Control, University of Kwa-Zulu Natal.

1.24 What type of PPE is provided and when do you use it?

	Type			**When do you use them?**			**How often do you replace it?**			**Have you ever been trained to use these?**	
		Yes	*No*	*All the time*	*All infectious patients*	*Only when dealing with TB patients*	*After each patient*	*Daily*	*Weekly*	*Yes*	*No*
Respiratory Protection	Paper Masks										
	Surgical Mask										
	N (95)										
	N (99)										

Annexure Dii

IMIBUZO NGABASENZI BEZEMPILO BASE X-RAY

Sawubona,

Ngiyabonga ukuvuma kwakho ukuzimbandakanya nalolucwaningo. Yazi ukuthi izimpendulo zakho zizoba yimfihlo, futhi zihlonishwe kakhulu. Lolucwaningo luhlose ukubheka ukuxhumana noma ukuhlangana phakathi kwezinto ezifana nobulili bomuntu, iminyaka, ubuzwe, ukuthi wake wabanaso yini isifo sofuba, indawo azalelwe kuyo nokunye nokunye (demographics) nomsebenzi awenzayo kanye negciwane elingakaveli (elilele) lesifo sofuba, ezisebenzini zalapho kushaywa khona izithombe (x-ray) ezibhedlela zika Hulumeni eThekwini namaphethelo. Loluhlobo locwaningo luyandingeka ukuze lwazise ngempilo yasemsebenzini kanye nendlela yokuhlola abasebenzi ikakhulukazi lapho kushaywa khona izithombe (x-ray).

Nakhu okumele ukwenze: Gcwalisa lemibuzo engenzansi ngokucophelela.
Funda umbuzo ngamunye uphendule ngokwethembeka.
Lapho kukhona amabhokisi ( ) thika.
Imibuzo enezindlela zokuphendulwa engaphezu kweyodwa izobalulwa.
Uma kunemibuzo ongayizwa, khululeka ukubuza umcwaningi.

UMNININGWANE DEMOGRAPHICS

Inombolo yocwaningo _____

Usuku lokuzibandakanya nocwaningo _____

Indawo yezempilo _____

1.1 Iminyaka _____

1.2 Wake wahlolelwa isifo sofuba? Yebo 1 Qha 0

1.3 Uluphi uhlobo lwesifuba okwathiwa unalo?
Amaphaphu Yebo 1 Qha 0
Ngaphandle kwamaphaphu Yebo 1 Qha 0

1.4 Wake walashelwa isifo sofuba? Yebo 1 Qha 0

1.5 Uyalashelwa yini isifo sofuba njengamanje? Yebo 1 Qha 0

Uma uthe yebo kwenye yemibuzo engenhla ungaqhubeki nokugcwalisa lelifomu, ngoba ngeke usakwazi ukuhlolelwa leligciwane. Lonke ulwazi ozosinika lona luzoba yimfihlo, luhlonishwe kakhulu. Kufanele usibuyisele yonke lemibuzo noma ungayiphendulanga yonke, ukuze umcwaningi akwazi ukuvikela lonke ulwazi osinike lona. Uma unemibuzo mayelana nokukhishwa kwakho ocwaningweni thintana nomcwaningi. Ngiyabonga ukubambisana nawe kulolucwaningo.

Annexure Dii

1.6 Ubulili M 0 F 1

1.7 Ubuhlanga

Omnyama	1	Ikhaladi	2	Indiya	3	Omhlophe	4	Nabanye	5

1.8 Indawo ozalelwekuyo? Emzansi Africa 1 Kwelinye Izwe 0

1.9. Kwezomshado Ushadile Awushadile Wadivosa Washonelwa

1.10. Iliphi izinga eliphezulu leziqu onalo?
Ngaphansi kwebanga leshumi
Ibanga leshumi
Isitifiketi
National Diploma
Undergraduate Degree
Postgraduate Degree

CHAZA NGOMSEBENZI OWENZAYO KABANZI

1.11 Siyini isikhundla sakho emsebenzini?

Diagnostic Radiographer (ushaya izithombe zokuhlola izifo)	5
General assistant/ Porter (usiza nakuphi)	4
Administrator (ungumphathi)	3
Manager/ Assistant Manager (uyimfolomane)	2
Radiologist/Registrar	1
Darkroom Operator	0

Other (Nokunye)
Umakukhona kuchaze: _____

1.12 Unesikhathi esingakanani uqashiwe emsebenzini? _____

1.13 Unesikhathi esingakanani usebenza kulesisibhedlela? _____

1.14 Unesikhathi esingakanani uqashiwe umnyango wezempilo KwaZulu-Natal? _____

1.15 Ukhona yini umuntu osondelene nawe osolakala ukuba nesifo sofuba khetha kube kunye kulokhu okungenzansi?
Nsuku zonke Kanye ngesonto
Nyanga zonke Anginalwazi

1.16 Uma kunsukuzonke linganisa ukuthi kungaba amahora amangaki owachutha nalomuntu osolwa ukuba nesifo sofuba? _____

Annexure Dii

1.17 Ukhona yini osondelene naye, osekunesiqiniseko sokuthi unesifo sofuba, khetha okukodwa nge?

Nsuku zonke Masonto onke
Nyanga zonke Anginalwazi

1.18 Uma kusukuzonke, linganisa ukuthi amahora amangaki owachitha naye?

_____

1.19 Ukhona yini osebenza nawe okuke kwathiwa kunesiqiniseko sokuthi unesifo sesifuba enkathini edlule? Yebo 1 Qha 0

1.20 Uma impendulo kunguyebo, bangaki kosebenza nabo abatholakala benesifo sofuba?

_____

1.21 Uma kunguyebo ku 1.19 batholakala nini nalesisifo. Ngenkathi eyedlule? _____

Isonto Inyanga
Unyaka Anginalwazi

1.22 Ngenkulu inhlonipho kulomsebenzi owenzayo, uyanikwa yini okokuzivikela?
Yebo 1 Qha 0

1.23 Uyakugqoka yini uma unikiwe? Yebo 1 Qha 0

1.24 Bheka iphepha elinanyathiselwa ukuphendula u 1.24

1.25 Uke waqashwa yini kwenye indawo? Yebo 1 Qha 0

1.26 Ngenkul inhlonipho kulomsebenzi phambi kwa owenzayo, ngiyacela uyaqedakala ukwaziswa ngezansi:

Umse-benzi	Isikhathi	Umqashi	Msebenzi muni	Ebungozini beTB (Y/Q)	Isivik-elo (Y/Q)	Ebungozini lothuli noma uketshezi (Y/Q)	Uma uvuma uhloboluni lothuli noma uketshezi
1.							
2.							
3.							
4.							
5.							
6.							

1.27 Uke usuke yini kulendawo osebenzela kuyo ngesikhathi somsebenzi?
Yebo 1 Qha 0

Annexure Dii

1.28 Uma impendulo kungu yebo ku 1.27 linganisa singakanani isikhathi osichitha ngaphandle kwase x-ray? _____

1.29 Sikhona yini isiqandisi emsebenzini? Yebo 1 Qha 0

1.30 Uma sikhona siqandisa indawo yonke osebenzela kuyo?
Yebo 1 Qha 0 Ungaaz□

1.31 Kungabe sibandisa indawo ethize kuphela?
Yebo 1 Qha 0 Ungaaz□

1.32 Chaza leyondawo? _____

1.33 Kungaba isiqandisi sisebenza ngokulingana na? Yebo 1 Qha 0

1.34 Uma uthe qha ku 1.29 no 1.33, Isebenzisa isishaya moya semvelo na (njengo kuvula iminyango namafasitela)? Yebo 1 Qha 0

1.35 Uma impendulo kungu qha ku 1.34 kungabe indawo osebenzala kuyo isebenzisa ophephela na? Yebo 1 Qha 0

UMNININGWANE YEMPILO

1.36 Ungasho ukuthi impilo yakho i?

Ayiyinhle	1	Iphakathi nendawo	2	Yinhle	3
Yinhle kakhulu	4	Yinhle kahle kakhulu	5		

Annexure Dii

1.37 Phendula lemibuzo eqondene nokuphefumula kwakho ngokuthikha.

A. Wake watshelwa udokotela ukuthi unesifo somoya?	Yebo 1	Qha 0
A. Usunaso?	Yebo 1	Qha 0
A. Wawungakanani uqala ukuzwa ngesifo sofuba?	Umnyaka	
A. Uma ungasenaso, wawungakanani siphela?		
B.1Wake watshelwa udokotela ukuthi unesifo senhliziyo?	Yebo 1	Qha 0
B.2 Wawuneminyaka emingaki uqala ukuzwa ngalesifo?	Umnyaka	
C1 uDokotela wake wakutshela ukuthi unesifo sepayipi lomoya?	Yebo 1	Qha 0
C2. Usenayo inkinga?	Yebo 1	Qha 0
C3. Uqale ukuzwa uneminyaka emingaki?	Umnyaka	
C4. Uma ungasenayo, sikuyeke uneminyaka emingaki?	Umnyaka	
D1. uDokotela wake wakutshela ukuthi unesifo samakhaza emaphashini?	Yebo 1	Qha 0
D2. Usenaso yini?	Yebo 1	Qha 0
D3. Uqale nini ukuzwa okokuqala ukuthi unamakhaza emaphashini?	Umnyaka	
D4. Uma ungasenaso, sikuyeke uneminyaka emingaki?	Umnyaka	
E1. Wake wakutshela udokotela ukuthi unomoya emaphashini?	Yebo 1	Qha 0
E2. Usenawo yini?	Yebo 1	Qha 0
E3. Uqale nini ukuzwa okokuqala?	Umnyaka	
E4. Uma ungasenawo, kuphele uneminyaka emingaki?	Umnyaka	
F1. Wake watshelwa udokotela kukhona imbali ethize engezwani nawe?	Yebo 1	Qha 0
F2. Usenayo?	Yebo 1	Qha 0
F3. Ubuneminyaka emingaki utshelwa lokhu?	Umnyaka	
F4. Uma ungasenaso, ubuneminyaka emingaki siphela?	Umnyaka	
G1. Wake walimala esifubeni?	Yebo 1	Qha 0
G2. Uma kunjalo, chaza		
H1. Wake wahlinzwa esifubeni	Yebo 1	Qha 0

1.38 Unazo yini lezizimpawu ezilandelayo?

Ukujuluka ebusuku	Yebo 1	Qha 0
Ukwehla emzimbeni	Yebo 1	Qha 0
Ukukhwehlela okungaphezu kwamasonto amabili	Yebo 1	Qha 0
Ukukhwehlela igazi	Yebo 1	Qha 0
Izinga lokushisa eliphezulu elenziwa yisifo esithile	Yebo 1	Qha 0

Annexure Dii

1.39 Wake wasihlolela isandulela gciwane? Yebo 1 Qha 0

1.40 uma kunjalo, ungathanda ukusazisa imiphumela?
Yebo 1 Qha 0

1.41 Imiphumela yayithini _____

1.42 Sikhona isifo onaso? Yebo 1 Qha 0

1.43 Uma impendulo ibe nguyebo ku 1.42 gcwalisa ngezansi:

Illness	Iminyaka yakho ngesikhathi uqala ukuzwa	"Diagnosed by" uDokotela	Imithi oyithola manje
Diabetes		Yebo 1 Qha 0	
Hypertension		Yebo 1 Qha 0	
Cancer		Yebo 1 Qha 0	
Eczema		Yebo 1 Qha 0	
Other:			

1.44 ulahlekelwe yisisindo esingaphezu kuka 5 kilograms enyangeni edlule?
Yebo 1 Qha 0

1.45 Izingubo zakho sezinkulu kuwe ngenxa yesisindo esilahlekile? Yebo 1 Qha 0

1.46 Ezinyangeni ezintathu ezidlule uke wakhishwa isisu esingaphezu kuka 3?
Yebo 1 Qha 0

1.47 Kulezinyanga ezintathu ezidlule umkhuhlane othathe ngaphezu kwenyanga?
Yebo 1 Qha 0

1.48 Uke wabanazo izilonda ezimhlophe emlonyeni ezinyangeni ezintathu ezedlule?
Yebo 1 Qha 0

1.49 Unazo izindlala ezivuvukele emqaleni nangaphansi kwa makhwapha?
Yebo 1 Qha 0

1.50 Uke waba nalo ibhande ezinyangeni ezingu 12? Yebo 1 Qha 0

1.51 Uke wabanaso isifo sentsholongwane enyangeni edlulileyo?
Yebo 1 Qha 0

Annexure Dii

1.52 Uma kungu yebo ku 1.51, bhala ngezansi:

Igama lesifo	Umuthi Ozoyithola	Uhlu Lwemithi ephuzwayo

1.53 Wake wajova nge BCG vaccine (kwasala isibazi engalweni) uzalwa?
Yebo 1 Qha 0

1.54 Uke wawuthola umgomo ezinyangeni ezidlule? Yebo 1 Qha 0

1.55 Uma impendulo ingu yebo e 1.54, bhala uhla?

Igama lomgomo	Usuku owagonywa ngalo

1.56 Ikhona imithi oyidlayo manje? Yebo 1 Qha 0

1.57 Iuma impendulo ingu yebo e 1.56, gcwalisa ngezansi?

Igama lomuthi	**Isilinganiso**	**Iminyaka eqala**	**Igunyazwe ngu Dokotela**	
			Yes	**No**

UMLANDOWAKHO NGOKUZIPHATHA EMPHAKATHINI

1.58 Uyabhema? Yebo 1 Qha 0

1.59 Uma impendulo kunguyebo ngenhla phendula lemibuzo elandelayo:

A. Wawuneminyaka emingaki uqala ukubhema	Umnyaka	
B. Uke wabhema okungenani ogwayi abangu 100 empilweni yakho	Yebo 1	Qha 0
C.Ubhema ogwayi abangaki ngelanga		
D. Usunesikhathi esingakanani ubhema logwayi		
E. Uke wayeka isikhathi esingangonyaka noma ngaphezulu	Yebo 1	Qha 0
F. Ukewazama ukwehlisa isibalo sikagwayi lona owubhemayo	Yebo 1	Qha 0
G. Ngaphambi kokwehlisa isibalo osibhemayo zonke izinsuku zokububhema omungaki ngelanga		

Annexure Dii

1.60 Wake walibhema ipipi kaningi? Yebo 1 Qha 0

1.61 Uma umpendulo kunguyebo phendula imibuzo ngezansi:

A. Wawunemunyaka emingaki uqala ukubhema ugwayi oyimpuphu	Umnyaka	
B. Ubhema ogwayi ezingaki igremu ngelanga		
D. Inganisa mingaki imunyaka ubhema lesisilinganiso		
E. Uke wazama ukuyeka esikhathini esinga ngonyaka noma ngaphezulu	Yebo 1	Qha 0
F. Uke wazama ukwehlisa isinganiso sikagwayi	Yebo 1	Qha 0

1.62 Wake wawubhema usikilidi kaningi? Yebo 1 Qha 0

1.63 Uma impendulo kunguyebo phendula imibuzo ngezansi:

A. Wawuneminyaka emingaki qala ukubhema usikilidi	Umnyaka	
B. Uke wabhema okungenani usikilidi oyikhulu empilweni yakho	Yebo 1	Qha 0
C. Ubhema usikilidi omingaki ngelanga		
D. Linganisa mingaki iminyaka ubhema lesisilinganiso		
E. Uke wazama ukuyeka esikhathini esinga ngonyaka noma ngaphezulu	Yebo 1	Qha 0
F. Uke wazama ukwehlisa isinganiso sikasikilidi	Yebo 1	Qha 0
G. Ngaphambi kokuba wehlise, ububhema omungaki ngelanga		

1.64 Uyaphuza? Yebo 1 Qha 0
1.65 Abantu bayakugxeka ngokuphuzal? Yebo 1 Qha 0
1.66 Uyathukuthela yini uma abantu beku gxeka uma uphuza utshwala? Yebo 1 Qha 0
1.67 Uyazisola ngokuphuza utshwala? Yebo 1 Qha 0
1.68 Ubanakho yini ukuthanda ukuphuza ekuseni kakhulu? Yebo 1 Qha 0

UMLANDO WOMNDENI

1.69 Yikuphi okuchaza kangeono isakhiwo sendlu ohlala kuyo?
Indlu enesakhiwo esisemethethweni endolobheni Yebo 1 Qha 0
Isakhiwo esingekho emthethweni endolobheni Yebo 1 Qha 0
Enkompolo Yebo 1 Qha 0
Imijondolo Yebo 1 Qha 0
Izindlu zasemakhaya Yebo 1 Qha 0

1.70 Bangaki abantu ohlala nabo ekhaya lakho? _____

Annexure Dii

1.71 Bangaki abantu osebenzisa nabo ikamelo lokulala? _____

1.72 Ukhona ugesi ekhaya lakho? Yebo 1 Qha 0

1.73 Uwena wedwa owondla ekhaya lakho? Yebo 1 Qha 0

1.74 Uma uphenduke ngocha ngenhla, bangaki abanye abasebenzayo?_____.

1.75 Uhola malini ngonyaka? _____

1.76 Ikhaya lakho linazo izinto ezishayisa umoya? Yebo 1 Qha 0

1.77 Mangaki amafastela ekhaya lakho? _____

1.78 Ikhaya lakho linako lokhu okulandelayo:

- Isifudumezi esphakathi nendawo Yebo 1 Qha 0
- Ducted air heating Yebo 1 Qha 0
- Isiqandisi Yebo 1 Qha 0

1.79 Iyiphi inhlobo oyisebenzisayo uma upheka?

- Ugesi Yebo 1 Qha 0
- Igesi Yebo 1 Qha 0
- Izinkuni Yebo 1 Qha 0
- Uphalafini Yebo 1 Qha 0
- Ilanga Yebo 1 Qha 0

1.80 Kukhona yini ekhaya otholakale enesifo sofuba? Yebo 1 Qha 0

1.81 Uma impendulo inguyebo gcwalisa ngezansi njalo uma kukhona emndenini otholakale enesifo sofuba:

Uhlobenekanjani nawe	Isifo sitholwe nini	Uhlobo lwe TB	Isikhathi esingakanani edla amaphilisi	Imiphumela yemithi	Bahlala nawe Yebo =1 Qha =0

Ngibonge kakhulu ukubambisana nawe kulolucwaningo. Konke osilekelele ngakho kusiyabulise kakhulu.

*Adapted from a medical study done by Dr. S. Naidoo and associates, 2012, Department of Occupational Health and Infection Control, University of Kwa-Zulu Natal.

1.24 Izinhlobo ukuvikelwa uyanikwa noma uyesenzise nini?

		Uhlobo		**Uyisebenzisa nini?**			**Uyisebenzisa kangakanani?**			**Wakufundela ukuwu sebenzisa?**	
		Yebo	*Qha*	*Sonke isikhathi*	*Kuzozonke iziguli ezinezifo ezithathelwananyo*	*Uma usebenza ngeziguli ezine TB kuphela*	*Emuva kwesiguli*	*Yonke imihla*	*Nges -onto*	*Yebo*	*Qha*
Eqondene Nokuphefumula Ukuvikelwa	Iphepha isisithelo										
	Surgical isisithelo										
	N (95)										
	N (99)										

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Annexure E

Data Sheet for TST Administration and Interpretation

To Whom It May Concern:

The following is a record of Mantoux tuberculin skin testing:

Name:_____ Date of birth:_____

Baseline TST/second TST: _____

Date and time test administered:_____

Administered by:_____

Manufacturer of PPD:_____

Expiration date:_____ Lot Number:_____

Date and time for test to be read:_____

Date read:_____

Results (in millimeters)_____

Read by:_____

Annexure F

TST contraindications

Tuberculin Purified Protein Derivative is a Food and Drug Administration (FDA) approved product. It is commercially known as Tubersol. Listed below are the contraindication as listed by the FDA.

Allergy to any component of TUBERSOL or an anaphylactic or other allergic reaction to a previous test of tuberculin PPD is a contraindication to the use of TUBERSOL.

TUBERSOL should not be administered to:

- Known tuberculin positive reactors because of the severity of reactions (eg, vesiculation, ulceration or necrosis) that may occur at the test site in highly sensitive persons,
- Persons with severe blistering tuberculin reactions in the past,
- Persons with documented active tuberculosis or a clear history of treatment for TB infection or disease, or
- Persons with extensive burns or eczema.

DEFERRAL

- Tuberculin skin testing should be deferred for patients with major viral infections or live-virus vaccination in the past month, for example vaccination against mumps or measles.
- Persons with the common cold may be tuberculin tested.

Annexure G

Interpretation of TST according to the CDC standards

The following classification is an excerpt take from the Division of TB Elimination, a division of the Centres of Disease Control and Prevention (2011: 1).

An **induration of 5 or more millimeters** is considered positive in:	An **induration of 10 or more millimeters** is considered positive in:	An **induration of 15 or more millimeters** is considered positive in:
• HIV-infected persons • A recent contact of a person with TB disease • Persons with fibrotic changes on chest radiograph consistent with prior TB • Patients with organ transplants • Persons who are immunosuppressed for other reasons (e.g., taking the equivalent of >15 mg/day of prednisone for 1 month or longer, taking TNF-α antagonists)	• Recent immigrants (< 5 years) from high-prevalence countries • Injection drug users • Residents and employees of high-risk congregate settings • Mycobacteriology laboratory personnel • Persons with clinical conditions that place them at high risk • Children < 4 years of age • Infants, children, and adolescents exposed to adults in high-risk categories	• any person, including persons with no known risk factors for TB. However, targeted skin testing programs should only be conducted among high-risk groups.

Due to this study being performed in a high-risk congregate setting, an induration of 10mm and more was considered positive. Staff that had a positive baseline reading were considered as infected with LTBI. Negative baseline readings required the administration of a second TST, one to three weeks later.

BIVARIATE CORRELATIONS

	Variable																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 – Size of induration 1 (median coded)																		
2 - Size of induration 2 (median coded)																		
3 – Age (median coded)	.26**	-.16																
4 – Gender	0.5	-.16	.18															
5 – Race	-.12	.08	-.16	.04														
6 – Marital status	.109	-.224	.505**															
7 - Highest academic qualification	.035	-.052	-.098	-.112	.028	-.041												
8 - Duration in current employment (years) (median coded)	.228*	-.158	.396**	.028	-.038	.367**	-.159											
9 - Duration in current hospital (years) (median coded)	.200*	-.158	.604**	.037	-.041	.364**	-.100	.691**										
10 - Duration employed in KZN DOH (years) (median coded)	.243**	-.158	.570**	.005	-.026	.475**	-.021	.688**	.693**									
11 - Average hours with individuals suspected of TB (hours) (median coded)	-.088	.192	-.400**	-.212*	.077	-.265**	.164	-.182	-.326**	-.234*								
12 - Average hours with TB cases (hours) (median coded)	-.088	.192	-.400**	-.212*	.077	-.265	.164	-.182	-.326**	-.234*	1.000**							
13 - How many do you know have been diagnosed with TB? (median coded)	.180	.267	.051	-.095	.100	.027	-.067	.204*	.122	.224*	.095	.095						
14 - How long spent away from the Department (median coded)	-.141		-.141	.076	.199	.201	-.079	.200	.028	.044	-.039	-.039	-.199					
15- How many people live in your home? (median coded)	-.018	.192	.084	.011	-.003	.072	-.009	-.085	0.000	-.093	-.113	-.113	-.054	.018				
16 - How many people do you share a bedroom with? (median coded)	.107	.267	.174	-.025	.060	.513**	-.107	.178	.125	.205*	-.028	-.028	.060	.043	.254**			
17 - How many other people at your home are employed? (median coded)	-.073	-.677*	-.225*	-.075	.234*	.210*	.134	-.152	-.164	-.128	.116	.116	-.058	.220*	.169	.058		
18- How many windows are there in your home?	-.025	.158	-.144	.022	.255**	.017	.149	-.207*	-.123	-.108	.119	.119	-.054	-.068	.228*	-.015	.305**	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Annexure I

Odds Ratio estimates of non-reference variables with the status of exclusion or inclusion

Category	Group	OR(95%CI)	*p*-value
Academic	Matric versus Certificate	1.158 (0.094-14.287)	0.909
	Matric versus National Diploma	0.483 (0.099-2.355)	0.901
	Matric versus Undergraduate	0.897 (0.035-22.975)	0.948
	Matric versus Postgraduate	0.474 (0.077-2.911)	0.420
	Certificate versus National Diploma	0.417 (0.049-3.542)	0.423
	Certificate versus Undergraduate	0.913 (0.030-27.828)	0.958
	Certificate versus Postgraduate	0.409 (0.040-4.147)	0.449
	National Diploma versus Undergraduate	1.577 (0.077-32.504)	0.768
	National Diploma versus Postgraduate	0.982 (0.281-3.429)	0.977
	Undergraduate versus Postgraduate	0.587 (0.026-13.531	0.740
Age	30-<40 versus 40-<50	1.085 (0.461-2.554)	0.852
	30-<40 versus 50-<60	0.756 (0.315-1.817)	0.532
	30-<40 versus 60-<70	0.964 (0.147-6.349)	0.970
	30-<40 versus 70-<80	1.947 (0.075-50.410)	0.688
	40-<50 versus 50-<60	0.697 (0.285-1.706)	0.429
	40-<50 versus 60-<70	0.889 (0.134-5.902)	0.903
	40-<50 versus 70-<80	1.800 (0.069-46.811)	0.724
	50-<60 versus 60-<70	1.275 (0.190-8.546)	0.802
	50-<60 versus 70-<80	2.561 (0.098-66.954)	0.572
	60-<70 versus 70-<80	2.143 (0.059-77.541)	0.677
Health Facility	Addington versus Clairwood	3.611 (0.376-34.692)	0.266
	Addington versus King Edward VIII	1.107 (0.422-2.908)	0.836
	Addington versus MGMH	2.167 (0.569-8.256)	0.257
	Addington versus OGH	0.361 (0.057-2.277)	0.278
	Addington versus PMMH	1.062 (0.414-2.726)	0.900
	Addington versus RKK	1.846 (0.646-5.275)	0.253
	Addington versus Wentworth	1.926 (0.427-8.688)	0.394
	Claiwood versus King Edward VIII	0.307 (0.033-2.891)	0.302
	Claiwood versus MGMH	0.600 (0.053-6.795)	0.680
	Claiwood versus OGH	0.100 (0.007-1.544)	0.099
	Claiwood versus PMMH	0.294 (0.032-2.746)	0.283
	Claiwood versus RKK	0.511 (0.052-5.003)	0.564
	Claiwood versus Wentworth	0.533 (0.043-6.655)	0.626
	King Edward VIII versus MGMH	1.957 (0.530-7.217)	0.314
	King Edward VIII versus OGH	0.326 (0.053-2.008)	0.227
	King Edward VIII versus PMMH	0.959 (0.392-2.350)	0.927
	King Edward VIII versus RKK	1.667 (0.608-4.569)	0.321
	King Edward VIII versus Wentworth	1.739 (0.397-7.623)	0.463
	MGMH versus OGH	0.167 (0.022-1.282)	0.085
	MGMH versus PMMH	0.490 (0.135-1.778)	0.278
	MGMH versus RKK	0.852 (0.217-3.349)	0.818
	MGMH versus Wentworth	0.889 (0.155-5.084)	0.895
	OGH versus PMMH	2.941 (0.483-17.896)	0.242
	OGH versus RKK	5.111 (0.792-32.969)	0.086
	OGH versus Wentworth	5.333 (0.619-45.993)	0.128
	PMMH versus RKK	1.739 (0.648-4.661)	0.272
	PMMH versus Wentworth	1.813 (0.420-7.832)	0.425
	RKK versus Wentworth	1.044 (0.225-4841)	0.957
Marital Status	Divorced versus Widowed	0.200 (0.007-5.866)	0.351
	Divorced versus Married	1.126 (0.050-25.350)	0.940
	Widowed versus Married	5.889 (1.024-33.868)	0.047

Category	Group	OR(95%CI)	*p*-value
Race	African versus Coloured	4.011 (0.214-75.152)	0.353
	African versus Indian	1.386 (0.532-3.615)	0.504
	African versus White	0.227 (0.040-1297)	0.095
	Coloured versus Indian	0.345 (0.019-6429)	0.475
	Coloured versus White	0.059 (0.002-1.464)	0.084
	Indian versus White	0.164 (0.029-0.929)	0.041
Job Title	Manager/Assistant Manager versus Administrator	0.263 (0.065-1.064)	0.061
	Manager/Assistant Manager versus General Assistant/Porter	0.068 (0.013-0.367)	0.002
	Manager/Assistant Manager versus Diagnostic Radiographer	0.583 (0.152-2.234)	0.431
	Manager/Assistant Manager versus Other	0.188 (0.037-0.946)	0.043
	Manager/Assistant Manager versus Darkroom Operator	0.188 (0.043-0.816)	0.026
	Administrator versus General Assistant/ Porter	0.260 (0.069-0.975)	0.046
	Administrator versus Diagnostic Radiographer	2.222 (0.951-5.195)	0.065
	Administrator versus Other	0.714 (0.207-2.467)	0.595
	Administrator versus Darkroom Operator	0.714 (0.253-2.019)	0.526
	General Assistant/ Porter versus Diagnostic Radiographer	8.556 (2.423-30.211)	0.001
	General Assistant/ Porter versus Other	2.750 (0.583-12.976)	0.201
	General Assistant/ Porter versus Darkroom Operator	2.750 (0.681-11.112)	0.156
	Diagnostic Radiographer versus Other	0.321 (0.099-1.040)	0.058
	Diagnostic Radiographer versus Darkroom Operator	0.321 (0.123-0.840)	0.021
	Other versus Darkroom Operator	1.000 (0.268-3.737)	1.000