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ADHERENCE TO AND USAGE OF THE N95 DISPOSABLE RESPIRATOR MASK AS A TB CONTROL MEASURE IN HEALTHCARE FACILITIES IN THE TSHWANE DISTRICT

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree

of

Master of Science in Nursing

Johannesburg, 2010

DECLARATION

I, William Khabe Malebati, declare that this research report work is my own work. It is being submitted for the degree of Master of Science in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

_____

William Khabe Malebati

Date _____

DEDICATION

To my wife, Francinah, my daughter, Tshepiso and my son, Keagile, for their continuous support and understanding throughout my studies, I would like to thank you because without you this study would not be meaningful.

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ABSTRACT

The purpose of the study was to determine the adherence to and usage of the N95 respirator mask as a TB control measure in healthcare facilities in the Tshwane district during managing a patient suspected or confirmed with pulmonary TB infection.

A cross-sectional, descriptive survey design was used to collect the data. A sample of 204 healthcare professionals and healthcare workers working in five healthcare facilities in the Tshwane health district met the inclusion criteria for this study. More than 83.33 %(n=170) of the staff were nurses; physiotherapists in the healthcare facility constituted the lowest percentage (1.96%; n=4). Chi-square test was done to test whether there was a significant difference between knowledge on the fit test of the N95 respirator mask and the healthcare professionals and healthcare workers. There was no significant difference in knowledge across the five staff categories P-value of >0.05.

Ensuring successful protection of the healthcare workers from contracting M-TB in the TB healthcare facilities depends on effective implementation of a respiratory protection programme and the correct usage of the N95 respirator mask.

ABBREVIATIONS AND ACRONYMS

AIIR	Airborne Infection Isolation Room
CDC	Centre for Disease Control
DoH	Department of Health
HCW	Healthcare worker
HIV	Human Immune deficiency Virus
IPC	Infection Prevention and Control
M-TB	Mycobacterium Tuberculosis
MDR-TB	Multi-drug resistant tuberculosis
MRC-SA	Medical Research Council in South Africa
NDoH	National Department of Health
NIOSH	National Institute for Occupational Safety and Health
OHS	Occupation Health and Safety
OHSA	Occupational Health and Safety Administration Act
REU	Research and Education Unit
RHRU	Reproductive Health & HIV Research Unit
TB	Tuberculosis
TST	Tuberculin skin test
UVGI	Ultra Violet Germicide Irradiation
WHO	World Health Organization
XDR-TB	Extensively drug resistant tuberculosis

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CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 Background

The prevalence of Tuberculosis globally is increasing at an alarming rate. According to the World Health Organization (WHO) 2009 report, approximately 9 million new cases of tuberculosis (TB) emerge globally every year. Out of these reported cases, close to 2 million people die from the TB disease annually, this amounts to approximately 5000 cases every day. The highest rates (100/100 000 or higher) are observed in Sub-Saharan Africa. TB is a pandemic as in Africa forms 30% of the TB cases and Asia 55%, India and China alone account for 53% of all cases (WHO, 2010). According to the World Health Organization's (WHO, 2009) global TB report, estimates of TB incidence have increased from 338 in every 100,000 persons in 1998 to 940 in every 100,000 persons in 2006. TB continues to spread uncontrollably in high Human Immune deficiency Virus (HIV) endemic sub-Saharan Africa and it has become the predominant cause of death of HIV infected people (Fourie, 2010). South Africa had nearly 460,000 new TB cases in 2007 with an incidence rate of an estimated 948 per 100,000 persons (Marais, Hoelscher, Mwaba, Dheda, Zumla, 2010). The reported incidence of TB in the Gauteng Province, City of Johannesburg in the year 2007-8 was 542/100,000 (Reproductive Health & HIV Research Unit, 2009).

In addition, a study conducted by the South African Department of Health in 2006 reported that 6.2 million South Africans were infected with HIV, 2 million of whom are likely to get TB in their lifetime. Approximately 55% of TB patients are HIV positive. The South African National Department of Health's actual TB registration reports indicate TB smear positive rates per

province (per 100 000 of total population); 285 for Western Cape, 300 for Eastern Cape and 328 for Northern Cape. All other provinces had an infection rate below 200. The Western Cape is regarded as one of the regions with the highest TB rate in the world (Fourie, 2010). Arguably, TB is the most common opportunistic infection and the biggest killer among people living with HIV infection. TB in South Africa creates major health problems as the country is ranked fourth out of the 22 high burden TB countries in the world (South African National Tuberculosis Infection Control Guidelines, 2009).

Tuberculosis (TB) is a well recognised occupational hazard for healthcare workers (CDC, 2006). Tan and Kamarulzaman (2006) in their study of preventing TB in healthcare workers in Malaysia, found that, 25 healthcare workers working in 11 general hospitals in Malaysia were infected with TB in 2004. The Malaysian media report raised major concerns on the safety of healthcare settings. As the disease burden is generally high in Malaysia, it was suggested that due attention should be given to the diseases in the healthcare facilities especially in areas where the infection control programme has been neglected.

The Medical Research Council in South Africa (MRC-SA) indicates that South Africa is burdened by the emergence of multi-drug resistant tuberculosis (MDR-TB) strain, the worst TB epidemic in the world, with disease rates more than double those observed in other developing countries and up to 60 times higher than those currently seen in the USA or Western Europe (Fourie, 2010). The TB problem in South Africa is largely as a result of historically neglected or poor management systems, compounded by the legacy of fragmented healthcare services. The impact of HIV/TB in provinces like Gauteng, KwaZulu-Natal and Mpumalanga contributes to the sharp increase of the

tuberculosis rate in these areas. The MRC-SA predicts dramatic change in the epidemiological profile of TB over the next five years. It is predicted that increasing rates are likely to continue and will be more pronounced in provinces with the fastest growing HIV infection rates. It is estimated by the MRC-SA that unless effective infection control measures are achieved, the current trends in the epidemic will continue resulting in 3.5 million new cases of TB and at least 90 000 death over the next decade. The financial implications are serious given that more than US $100 million are spent annually on TB in South Africa, and an excess of US $3 billion would be required over the next 10 years if the current rate of TB is allowed to continue without appropriate interventions (Fourie, 2010).

In addition, the TB epidemic in South Africa is compounded by multi-drug resistant tuberculosis (MDR-TB) and extensively drug resistant tuberculosis (XDR-TB). Multi-drug resistant tuberculosis (MDR-TB) is caused largely by non-adherence to TB drug regime or inappropriate drug regime, which further exacerbates the epidemic. New laboratory results of MDR-TB tripled from 2,000 cases in 2005 to 6,716 in 2007. MDR-TB isolates collected from 2004-2007 showed that 6.5 percent (986) of 17,615 TB cases were XDR-TB. The actual reporting of XDR-TB has also increased from 74 in 2004 to 536 in 2007 (USAID, 2009). MDR-TB is a strain of Mycobacterium Tuberculosis with resistance to at least Isoniazid and Rifampicin and is caused mainly by non-compliance to TB treatment. In XDR-TB there is resistance to Isoniase and Rifampicin, and additional resistance to any Fluoroquinolone and at least one of three injectable second line drugs, Capreomycin, Kanamycin and Amikicin (South African National Tuberculosis Infection Control Guidelines, 2007:38).

Airborne transmission of the Mycobacterium Tuberculosis and other infectious agents within the hospital environment is a well recognised hazard for healthcare workers. Mycobacterium Tuberculosis is a gram-positive bacterium characterised by unusual straining properties. Acid fast bacilli (AFB), unlike most bacteria, have cell walls that retain the strain even after treatment with strong acid. It is carried in airborne particles as droplet nuclei that can be generated when a person coughs, sneezes or shouts. The particles are generally 1-5µm; it can remain floating in the air for a very long period in a close environment with poor air circulation (Biscotto, Pedroso, Starling and Roth, 2005). Primary infection occurs on first exposure to tubercle bacilli, inhaled droplet nuclei that are so small that they avoid the muco-ciliary defences of the bronchi and lodge onto terminal alveoli of the lung, where the organisms replicate. The number of organisms expelled into the air, the concentration of organisms in the air and the length of time an exposed person breathes the contaminated air will determine the likelihood of transmission of Mycobacterium Tuberculosis. Reported TB outbreaks in the healthcare setting, involve transmission of multi-drug resistant tuberculosis strain to both patients and healthcare workers. The highest risk of exposure to TB-associated transmission in the hospital environment is from patients with unrecognized TB disease who are not managed with appropriate airborne precautions (Biscott *et al*, 2005:545-549).

The usual site of infection is the lungs, where Pulmonary Tuberculosis (TB) occurs (Minnaar, 2008:74). Personal respiratory protection involves the selection of personnel for training and the use of respirators. Respiratory protection such as the use of the N95 respirator high efficiency respirator mask has been helpful in protecting the healthcare worker from contracting TB and it is recommended and preferred as a respirator mask in TB settings (South African National Tuberculosis Infection Control Guidelines 2007:17). These respirators are used to protect the

healthcare workers from contracting TB through inhalation when performing procedures or caring for TB infected patients in TB hospital or clinics. Personal respiratory protection standard precautions must also be maintained with all patients at all times especially in TB treatment areas.

The overall effectiveness of respiratory protection is based on the level of respiratory protection selected, the fit characteristic of the N95 respirator mask and donning of the N95 respirator mask. N95 respirator masks are recommended for the safety of employees who may be exposed to low levels of certain respiratory infectious agents in the healthcare environment (Paul. Jensen. Michael. Lambert, Michael, Iademarco and Renee, 2005). However, administrative and environmental control alone might not adequately protect healthcare workers from occupational transmission TB. In October 1997 the Occupational Health and Safety Administration Act (OHSA) published proposed standards for occupational exposure to Mycobacterium Tuberculosis. The introduction of respirator masks in the TB respiratory protection program in a situation that posed high risk exposure to Mycobacterium Tuberculosis is enforced and regulated as the standard for TB protection. In December 2003 the OHSA specified the use of N95 respirator masks for the protection against Mycobacterium Tuberculosis in the healthcare setting. The usage of the N95 mask is now regulated by OHSA and the Compliance Policy Directive (Paul *et al*, 2005).

Since the increase of MDR-TB and XDR-TB infections in healthcare facilities, the South African National Department of Health has enforced as policy, the usage of the N95 respirator mask in TB hospitals and in areas where patients with diagnosed or suspected TB are managed. However, adherence to policy and compliance in relation to the usage of the N95 respirator mask in TB settings is still questionable. There are an increased number of healthcare workers in various

healthcare facilities, who contracted TB, possibly during the care of TB patients (Biscotto *et al* 2005:545; Tan & Kamarulzaman 2006*)*. As reflected in **Table 1.1** there are 22 new cases reported of healthcare workers who have contracted TB over the past three years. This incidence is on the increase compared to previous years. Since the establishment of the Labour Relations Act in 1995, (Act 66 of 1995) pre-screening tests for newly appointed staff became more passive as both employer and employee became reluctant to undergo screening. No statistics have been compiled previously, as healthcare workers in general, do not want to disclose their exposure to TB. The number of healthcare workers suspected to have contracted TB at their workplace is estimated to be 22. These statistics may not be accurate as some healthcare workers fail to report, because of fear of stigmatisation. The number of healthcare workers who reportedly contracted TB may be higher than what is reflected. **Table 1.1** below indicates reported cases of TB in healthcare workers between 2005 and 2007.

Table 1.1 Number of TB cases in healthcare - professional and worker (n=22)

Categories of staff	Jubilee Hospital	Mamelodi Hospital	Tshepong Hospital	Laudium PHC	ODI District Hospital	Total
Nurses	3	2	1	2	3	
Doctors						
General assistants	2	2		3	3	
Clerks				1		
Total	5	4	1	6	6	22

TB statistics for these institutions between 2009 and 2010 indicate an additional five (5) nurses who contracted TB between December and March. Since these nurses were employed for a period

of five years and no pre-screening test had been done to them, it may be assumed that TB was contracted in the workplace. This report increases more suspicion that there might be more staff that contracted TB in the workplace. However, they remain unknown, possibly because they are afraid of stigmatisation as mentioned earlier. A study by Francis (2007) indicates that nine in ten people with normal immune system with latent TB infection will never develop the TB disease. However, one in ten of those infected will develop the TB disease at some time in their lives, though the risk is lower if they receive preventive therapy. About half of these will develop the TB disease within two years after they become infected. Paul *et al.* (2005) recommend that all healthcare workers should receive baseline TB screening upon hire, even in the settings considered to be low risk or during transfer to a situation regarded as high risk.

1.2 Problem statement

According to statistics from healthcare facilities in the Tshwane district, the number of reported cases of healthcare workers who contracted TB in the workplace over the past two years is on the increase. Although several measures, including a **respiratory protection programme**, have been put in place by OHSA jointly with the National Department of Health to reduce the risk of spreading Tuberculosis in the healthcare settings, non-adherence by healthcare professionals and workers can potentially derail such measures. In the context of this respiratory protection programme, National Department of Health has introduced a policy on the usage of the N95 respirator mask for healthcare workers when managing patients with diagnosed or suspected TB. The intention was to reduce the risk of TB transmission in healthcare settings. Without formal training and research evidence, it is not known to what extent operational aspects are followed or

whether healthcare workers are compliant in using the N95 respirator mask. The questions to be addressed in this research are as follows:

- To what extent is the respiratory protection programme operational in TB facilities?
- Do employees undergo medical evaluation and fit testing prior to using the N95 respirator mask?
- To what extent do employees adhere to practices in using, maintaining and disposing the N95 respirator mask?

1.2 Study purpose

The purpose of the study was to determine healthcare professionals and workers adherence to and usage of the N95 respirator mask as a TB control measure in TB settings in the Tshwane district.

1.4 Objectives

The objectives of the study were to:

- Determine the demography and workplace profile of healthcare professionals and healthcare workers in TB settings in the Tshwane district
- Determine the implementation of the respiratory protection programme for TB infection prevention and control with reference to:
    - Policy and administration
    - Medical evaluation

- Fit testing

- Determine participants' reported adherence to the correct usage and disposal of the N95 respirator mask.

1.5 Operational definitions

The study variables were defined as follows:

- **N95 respirator mask** refers to an air-purifying, filtering-face respirator that is ≥95% efficient at removing 0.3µm particles and is not resistant to oil.
- **Adherence** means following the infection prevention and control standards and the correct way of doing procedures. i.e. Healthcare professionals and workers are able to follow the OHSA respirator protection programme (fit test procedure) when using the N95 mask when managing suspected or confirmed TB patients in a TB setting.
- **Healthcare workers** are defined as all persons employed in healthcare settings where patients are either diagnosed as or suspected of having TB. In this study it includes general workers and clerks.
- **Healthcare professionals** are defined as all certificated or qualified persons working in the healthcare setting where patients are either diagnosed or suspected to have TB. In this study it includes nurses, doctors and physiotherapists, registered with their professional councils.
- **TB settings** are areas designated in the healthcare setting where treatment and care is rendered to patients diagnosed with or suspected of having TB. These may be primary

healthcare clinics or hospitals.

1.6 Conclusion

This chapter introduced the study and stated the research problem, study objectives and operational definitions; it described the epidemiological trends, the prevalence of TB and impact of TB in the healthcare settings in South Africa. The next chapter will discuss the literature study in detail.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter emerges from a process of reading, understanding and forming conclusions about published research and other academic texts that are related to the area under research. This review presents and critiques the existing body of literature to provide an understanding of the existing knowledge of the problem and a rationale for the research question. This literature review provides an understanding of and insight into the transmission, infection prevention and control measures and respiratory protection in respect of pulmonary tuberculosis (TB) in healthcare settings.

2.2 Overview of Pulmonary Tuberculosis

Tuberculosis (TB) historically was imported into South Africa during the late 1800s and the first half of the1900 (RHRU, 2009). The discovery of gold and diamond resulted in an influx of migrants from African and European countries to South African mines. Many miners who come from Europe contracted TB (RHRU, 2009). Poor working and living conditions in the mines, migrant labour and the lack of effective chemotherapy has facilitated the spread of TB in the country. After 1950 the incidence of TB declined with the introduction of Isonazid and Rifampicin therapy (RHRU, 2009). The dramatic spread of HIV epidemic throughout sub-Saharan Africa in the past decades has been accompanied by up to a fourfold increase in the number of TB cases registered by the National TB programme (Stop TB, 2006). In essence, TB has reached epidemic

proportion in South Africa. Reports by the WHO indicate that South Africa has the fourth highest incidence (new cases) of TB in the world. Meanwhile, the incidence of TB continues to increase parallel with the prevalence of HIV infection, and despite the efforts to strengthen the TB control programme, the burden of diseases from TB continues to rise. The factors contributing to the increase of TB burden include:

- Poverty and rapid urbanisation
- The impact of the HIV-pandemic
- Poor health infrastructure
- Poor programme management with inadequate case detection, diagnosis and cure

The South African TB cure rate for 2004 was 56.7% against the target of 65% of smear positive clients detected (Stop TB, 2006). Efforts to curb this increase are focused on improving the Direct Observed Treatment Short course as well as integration of the HIV and TB programmes. For 2005 the TB treatment outcomes have improved with new smear positive cure rate of 58% and treatment success rate of 71% comparing to 2004 cure rates. The following are some of the challenges encountered that have impacted negatively in improving TB control.

- Inadequate financial and human resources for TB control programme
- Poor community participation in TB control programme
- Poorly trained or supervised health personnel
- Poor documentation of cure (high completion rates), defaulter rates over 10% and large number of cases not evaluated

- Low level of integration in TB and HIV service at patients management level
- Increase number of MDR-TB and XDR-TB cases

The mission of the Department of Health in South Africa is to prevent TB and to ensure that those who do contract TB have easy access to effective, efficient and high quality diagnosis, treatment and cure that reduces suffering.

2.3 Risk of transmission of Mycobacterium Tuberculosis

2.3.1 Transmission to people in general

Infection with Mycobacterium Tuberculosis may occur at any age. Once infected with Mycobacterium Tuberculosis, a person can stay infected for many years, probably for life (Stop TB, 2006). The majority of people without HIV infection who are infected with Mycobacterium Tuberculosis may not develop TB (Stop TB, 2006). Mycobacterium Tuberculosis can only be identified by tuberculin skin test (TST). TST measures the body `s immune response to the injection of purified protein derivative from TB bacilli; an amount of 0.1 ml of tuberculin is injected into the anterior surface of the forearm. The reaction is identified by a raised small bump (swelling) of 5mm or more in diameter on the injection site (South African National Tuberculosis Infection Control Guidelines, 2009). Infected persons can develop TB at any time in their lifetime and the disease can infect any tissues or organs in the body, especially the lungs. Infected young children and infants are at greater risk of developing diseases than adults because their immune

system is not fully developed. Children who develop diseases do so within two years following exposure and infection (Stop TB, 2006).

Becoming infected with Mycobacterium Tuberculosis bacteria's depends on the concentration of organisms in the air, the duration of exposure to air contaminated with Mycobacterium Tuberculosis bacteria and the aerosols of the droplet nuclei (MDR-SA Guideline, 2007). Persons with infectious tuberculosis may have between 107 and 108 organisms in a cavitations lesion. A 10 μm droplet nucleus may carry three to ten tubercle bacilli. In indoor environments, droplet nuclei can remain suspended in the air for long periods of time, unless they are removed by ventilation or filtration. Virtually all transmission occurs in enclosed environments. The probability of a person becoming infected during a one-hour exposure period has been estimated to range from 1 in 600 (0.2%) to 1 in 4 (25%) (MDR-SA Guideline, 2007). One cough can produce 3,000 droplets nuclei and sneezing up to a million. The magnitude of the risk varies considerably by the type of facility, prevalence of TB in the community, the patient population served, healthcare workers occupational group, the area of healthcare facility in which the HCW works and the effectiveness of TB infection prevention and control interventions (CDC/NIOSH, 2010). Congregate settings like correctional services, military barracks, homeless shelters, refugees' camps, churches and nursing homes remain the dominant source of TB infections. Reducing overcrowding in such areas is one of the important measures to reduce TB transmission.

2.3.2 Transmission to healthcare workers in particular

Tr**a**nsmission of Mycobacterium Tuberculosis is a risk to workers in healthcare settings. Nosocomial transmission of Mycobacterium Tuberculosis has been associated with close contact with a person who has infectious TB. Performing procedures like cough-inducing aerosolized treatment and endo-tracheal intubation increases potential risk of Mycobacterium Tuberculosis transmission (CDC/NIOSH, 2010).

In addition, the risk of transmission to healthcare workers of TB infection varies with job categories. Healthcare workers who are in contact with patients are at more risk than those with no patient contact. Other healthcare workers who are at high risk are those working with respiratory generating aerosols from patients, including bronchoscopes, endo-tracheal suctioning, intubation, cough and sputum induction. Working with the unsuspected TB infected patients or exposure in circumstances of poor ventilation also poses high risk of transmission to healthcare personnel (Daniel, 2001).

As a result, the risk of TB transmission has caused understandable alarm among healthcare workers about the safety of working in TB settings with a large number of admissions of TB suspected or confirmed patients, especially with the high prevalence of multi-drug-resistance tuberculosis (MDR-TB). In their UK study, Biscotto *et al.* (2005) reported that about 1% to 10% of healthcare workers may be at risk of contracting tuberculosis infections annually in TB settings with more than 200 admissions per year for TB. Healthcare workers at high risk are those exposed to respiratory aerosol from patients with suspected or confirmed pulmonary TB infections. In

South Africa the estimates from the drug resistance TB survey conducted by the Medical Research council (MRC) in 2001-2002 indicated that the proportion of new patients with MDR-TB is now 1% to 3%; among previously treated patients this proportion is between 4% and 10% (Weyer, 2003). These proportions translate into more than 2500 cases of MDR-TB diagnosed every year (Sidney, 2004).

Furthermore, the World Health Organization (2009) reported that the transmission of TB is a recognised risk in healthcare facilities and communities, especially in facilities with limited resources where transmission is facilitated by inadequate TB infection control measures. The impact of the human immune-deficiency virus (HIV) epidemic, which has increased the occurrence of MDR-TB, and the emergence of XDR-TB have heightened the concern about TB transmission motivated the urgency to focus on TB infection control.

2.4 Infection Prevention and Control Measures

TB infection control was not seriously considered in the policy and practices of TB control in healthcare facilities and TB settings. Recent outbreaks and high mortality related to MDR-TB, XDR-TB and the prevalence of HIV have led to a strong focus on TB infection control in TB settings (WHO, 2009). TB infection prevention and control need to be extended to the community. Education of patients and increasing community awareness can bring positive attitude and removing the stigma of TB in patients living with TB. Basic infection control programmes such as community awareness campaigns, community information, education and involvement can promote and improve early identification of new TB cases as well as adherences to TB treatment.

Patients and communities should be educated about the symptoms and signs of TB, how to protect themselves, their families and others by enforcing TB infection control strategies such as cough etiquette and respiratory hygiene. Introducing the infection control support, educating and counselling of families of people who are TB smear positive will help to minimise the stigma and exposure of non-infected patients to infected patients (WHO, 2009).

Thus, healthcare settings should implement policies and protocols that enforce prompt identification and management of persons who have suspected or confirmed infectious TB disease. Triage or early identification of patients suspected or confirmed, having TB infection is crucial. Triage and separation of infectious patients should be implemented in such a way that it will improve flow of patient to patient waiting area and protect uninfected patients and visitors (WHO, 2005). The immune-compromised patients for instance, HIV positive patients should be physically separated from highly infectious TB patients. These TB infection control measures are necessary to minimise the exposure of non-infected patients, particularly those who are immune-compromised, to infectious patients. To minimise the spread of droplet nuclei (airborne infections), any patient suspected or confirmed having TB infection, should be educated in cough etiquette such as covering their nose and mouth when sneezing or coughing (WHO, 2009).

In general, there are three levels of infection prevention and control in TB settings, namely administrative control, environmental control and respiratory control. These control measures are discussed in the sections that follow.

2.4.1 Administrative control

The first level of infection prevention and control in the hierarchy is the administrative control; it is about planning to minimise the number of areas where exposure to TB may occur, training of staff and the development and implementation of infection prevention and control TB policies. Hospital and clinic administrators, including nursing managers, principal medical officers, public works and cleaning services should be aware of the risk to staff on account of the TB transmission in the healthcare facilities (Francis, 2007). The purpose of administrative control measure is to reduce the risk of exposure to persons who might have TB diseases (CDC, 2006). Administrative control consists of the following activities:

- Assigning the responsibility for TB infection control in the settings
- Conducting risk assessment
- Developing and instituting a written TB infection control plan
- Implementing effective work practices for management of patients with suspected or confirmed TB disease
- Training and educating HCW regarding TB
- Screening of employees for TB diseases

Administrative commitment to implementation of TB infection control is necessary to ensure success of TB preventative efforts (RHRU, 2009). Healthcare management should appoint multidisciplinary infection prevention and control committee. The committee should comprise of a top manager, nursing manager, professional nurses, TB programme nurse, nursing assistants,

general cleaning representative, maintenance, receptionist and security (RHRU, 2009). The responsibilities of a multidisciplinary committee are:

- To meet monthly
- Produce and update a TB infection control plan
- To review quality of TB infection control in the facility
- Reviewing the implementation of TB infection control protocols
- Monitoring and assessment of allocated budget for building of TB shelters, waiting area and installation of TB preventative measures e.g. Ultra Violet Germicide Irradiation lights and propeller fans

2.4.2 Environmental control

The second level is environmental control, which involves reducing the concentration of airborne TB infections by the usage of Ultra Violet Germicide Irradiation (UVGI) lights and ventilation (CDC, 2006). Ventilation is the movement of air through a building so that it is replaced by air from outside; it includes natural and mechanical ventilation. Natural ventilations rely on open doors and windows. There should be enough open windows on a build area to allow good ventilation. Open windows on opposite sites allow cross ventilation in a room or building. To ensure good ventilation in a building, windows and doors should be kept open. Mechanical ventilation can be used in areas where there may be high concentration of infectious droplets nuclei. The system facilitates air entry into the room and extraction of air from the room to outside. Similarly, exhaust ventilation allows for exchange of air in the room as well as extraction

of air to the outside. In negative pressure room ventilation, the room is kept at negative pressure by sucking out the contaminated air circulating inside the room to the outside through the exhaust chimney, thus ensuring that fresh air is drawn into the room.

In addition, the RHRU (2009) further describes ventilation as the removal of old, stale or diseased air and replacing it with new, fresh or clean air, removing infectious particles and diluting that remaining, so that the chances of inhaling infectious particles are kept to a minimum. CDC recommends 6-12 air change per hour for respiratory isolation rooms where suspected or confirmed TB patients are managed. Ultra Violet Germicide Irradiation (UVGI) lamps may be used as adjunctive measures as ultraviolet rays kill bacilli, ultraviolet germicide irradiation lamps kill the bacilli within five minutes. For the UVGI lamp to be effective the contaminated air has to come into contact with the ultraviolet rays, therefore circulation of air in the rooms is very important. This control measure is however ineffective in dusty and humid environment (South African National TB Infection Control Guidelines, 2009). Nevertheless, the risk of infection still occurs in a few work areas such as exposures to airborne infection especially in patient isolation rooms and coughing-induced areas (CDC, 2006). Because a person entering these areas may be exposed to TB infections, the third level in the hierarchy: personnel respiratory protection is applied.

2.4.3 Personal respiratory control

This study is about the assessment of the third level of protection: respiratory protection. Personal respiratory protection is about the usage of respirators that contain a special filter material that

protects the wearer from inhaling the bacilli. This also includes the implementation of the respiratory protection programme (CDC, 2006). Broadly, it is used as a last resort where all other measures have not completely eliminated the risks. Respiratory controls are used as short term protective measures against high risk exposure for example, during sputum collection or sputum induced procedures (South African National TB Infection Control Guidelines, 2009:94). If a respirator is used in the healthcare settings, the OHSA require the healthcare facilities to have a respiratory protection programme in place and it recommends the use of the certified N95 respirator mask by healthcare professionals and workers in the TB settings during the management of suspected or confirmed TB infected patients. The respiratory protection programme is all about selection of the respirator mask, fit testing and personnel medical evaluation.

2.5 Respiratory Protection Programme (N95 Respirator Mask)

To establish a proper and effective respiratory protection programme, standard operational procedures (SOP) must be established. One person must be in-charge of the programme and be given the authority and responsibility to manage all aspects of the programme. The programme administrator should have the background and knowledge of implementing the respiratory protection programme (CDC/NOISH, 2010).

The Centre for Disease Control (CDC, 2006) recommends the usage of the N95 respirator mask for the safety of healthcare workers who may be exposed to Mycobacterium TB in various TB settings. As a consequence, N95 respirator masks are being used worldwide to protect healthcare workers from contracting TB infection through inhalations when dealing with suspected or a

diagnosed TB patient. To achieve the maximum protection of the N95 respirator mask by healthcare workers in TB settings: the **Respiratory Protection Programme** must be enforced in all healthcare employees in TB settings. The elements of a Respiratory Protection Programme as required by OHSA included: training of HCWs, selection of correct appropriate mask; fit test procedure; correct usage and respirators maintenance; storing and disposing of respirator mask (CDC 2006).

Healthcare workers are required to wear the N95 respirator mask when caring for suspected or confirmed TB infected patients, when entering rooms in which patients with suspected or confirmed infectious TB diseases are being isolated; when present during cough-induced or aerosol-generating procedures performed on patient with suspected or confirmed TB diseases and when in other settings in which administration and environmental control are not likely to protect them from inhaling infectious airborne droplet nuclei. Also included are health workers who transport patients with suspected or confirmed TB diseases in vehicles (e.g. EMS vehicles and ambulances) and those who provide urgent surgical or dental care to patients with suspected or confirmed TB diseases (CDC, 2006). Visitors and family members should also wear the N95 respirator mask when in enclosed confinement with the TB infected patient. Considering the stigma associated with the use of the N95 respirator mask, strong emphasis is placed on behaviour-change campaign for healthcare workers, patients and communities. The N95 respirator mask should not be used by patients or persons suspected or confirmed to have TB infection. Surgical face masks are more appropriate for patients to ensure proper cough etiquette (WHO, 2009).Surgical face masks have large pores, therefore they do not protect the healthcare workers and visitors are against Mycobacterium Tuberculosis. The respirator mask on the other hand, has

tiny pores which block droplet nuclei and releases air on tight seal around the edges, the N95 respirator mask can give up to 95% protection when used.

2.6 Training of Healthcare Workers

Training should be enforced for all healthcare workers and professionals with regards to infectious diseases associated with airborne transmission; risk assessment processes in relation to respiratory protection programme including signs and symbols should be used to indicate that respirators are required in certain areas and the reason for using respirators. Training of HCW includes: selection of respirator mask, fit testing, OHSA regulation regarding respirators, knowledge regarding to usage and the adherences to the N95 respirator mask. Trainers should be given an opportunity to handle and wear the N95 respirator mask during the training sessions.

2.6.1 Use of the N95 respirator mask

Respirator masks used in TB settings for protection against Mycobacterium Tuberculosis should meet specifications required by the National Institute for Occupational Safety and Health (NIOSH). The letter `N` in N95 refers to the fact that mask/filter is `Not resistant to oil`. It has the ability to fit the different facial sizes and characteristics of HCWs. It is thus available in different sizes and models (CDC/NIOSH, 2010).

OHSA requires a respiratory protection programme to be in place at TB settings where respirators are being used. The importance of the fit factor in respiratory protection was investigated

previously by Lee et al. (2005), who showed that the N95 respirator mask is highly efficient in filtering airborne microbial particles when the N95 respirator is sealed to the head form. The N95 respirator mask is a CDC/NIOSH certified respirator that meets the filtering performance for respiratory protection in areas where diagnosed or suspected TB patients are managed. The N95 respirator mask is an air purifying, filtering face piece respirator that is ≥95% efficient at removing 0.3µm particles not resistant to oil. However, laboratory studies on the N95 respirator mask performance in human subjects showed that the 95th percentile of the total penetrations for each respirator (95% of the wearer of the respirator can expect to have penetration value below the 95th percentile) without the fit testing ranged from 6% to 88%. When the fit testing screening was applied, the 95th percentile of the total penetrations for each respirator decreased to 1% to 16% with the mean value of 4% suggesting that the fit test is necessary to achieve a high level of protection.

Several studies used non-pathogenic micro-organisms having physical characteristics similar to that of Mycobacterium Tuberculosis to analyze microbial penetration through respirators. Some of the studies showed that high efficiency particulate air and the N95 respirator filter provides a higher level of protection than the dust/mist (DM) and the dust/mist/fume filter (DMF) mask (Rengasamy, Zhuang BerryAnn, 2004:348). According to the above information, it can be argued that the N95 respirators are effective for use as TB control measures by healthcare workers in a TB setting.

The South African Department of Health also recommends that the N95 respirator mask as respiratory TB control measure in TB settings, to protect healthcare workers from contracting TB.

Surgical masks were designed to prevent transmission via relatively large particles (sputum droplets) whereas the N95 respirator masks are made of materials certified to block 95% of particles 0.3μm in diameter. They also seal tight to block inflow from the nose and mouth. The Chinese Institute of Medicine supports the CDC in recommending the N95 respirator mask to protect healthcare workers from the pandemic flu (Barclay,2009). Surgical masks are not respirators and are not certified as such, and so, they do not protect the user adequately from exposure to TB (CDC/NIOSH, 2010).

2.6.2 Fit testing

Fit testing is the process of determining the extent to which the facial seal of the respirator prevents inward leakage of unfiltered air. It may be applied at several different points: To test newly designed respirator masks; to evaluate the worker prior placement to work with potentially Mycobacterium Tuberculosis exposure; or to evaluate an employee whenever a new respirator type is provided (Daniel, 2001). Fit testing is used to determine which respirator fits the user adequately. To ensure that the user knows when the respirator fits properly, periodic fit testing for respirators used in a TB environment can serve as an effective training tool; change in facial features (beards; facial scaring; cosmetic surgery and dental change) of the wearer which can alter facial seal such as; medical condition that would affect the respirator function; or physical characteristics of respirators, model or size of the assigned respirators (CDC, 2005:238).

According to a study conducted by Francis (2007:71) in the San Francisco Department of Public Health and the University of California, the effectiveness of the N95 respirator mask is determined

by face-seal and fit characteristics. A well-fitting respirator and a fit test produce better results than a well-fitted respirator without a fit test or a poor fitting respirator with fit test. The overall effectiveness of the N95 respirator mask protection is affected by the level of respirator selected, fit characteristics, the care in using the respirator and training on fit tests. The N95 respirator mask has been developed and instituted to enhance staff safety when:

- In presence of a suspected or confirmed infectious TB patient who is unable or unwilling to wear a mask
- Entering a room, including airborne isolation room, which has been occupied by suspected or confirmed infectious TB patient
- Transporting or accompanying a person with suspected or confirmed infectious TB patient in an enclosed vehicle
- In the presence of high risk procedures e.g. sputum induction

Occupational Safety and Health Act (OHSA) requires the developmental, administration and periodic revaluation of the respiratory protection programme in the TB settings when respirators are used by healthcare workers during the management of TB suspected or confirmed patients. Fit testing and checking is to identify which size of the N95 respirator mask is suitable for an individual and worn correctly. The risk manager approach should be applied by all healthcare workers working in high risk areas e.g. TB ward be fit tested. For the N95 respirator masks to give maximum desired protection, it is essential that the wearer is properly trained on fit testing and checking procedures. Fit testing procedures should take place in a well-ventilated room. The test utilises a substance that has a distinctive odour/taste. The wearer is advised not to suck, chew gum

or drink strong flavoured drink, such as coffee or tea, for at least fifteen minutes before performing fit testing. The wearer should conduct fit test check each time they wear the N95 respirator mask. When the wearer inhales sharply, the mask should collapse on the face, but if air can pass around the edge of the N95 respirator mask will not collapse, indicating that the seal is inadequate and the mask needs to be repositioned (CDC, 2010).

The N95 respirator mask will provide no protection if it is not properly fitted, as air will flow through gaps between the mask and the wearer's skin, fit testing should be done when selecting the type of the mask that the facility uses. Any facial hair, beard or long sideburns may prevent the respirator mask from fitting properly. Fitting of the N95 respirator mask should be done according to the manufacturer's instructions; to ensure that the mask is correctly worn, the wearer of the N95 respirator mask should inhale sharply, the respirator mask should collapse on your face. If the mask does not draw in towards your face or a leakage is felt at the edge, the strap must be adjusted by pulling back on the sides and repositioning respirator. This procedure should be repeated until respirator mask is sealed properly (RHRU, 2009).

2.7 Conclusion

This chapter outlined the literature reviewed, critiqued and analysed. The literature on risk of TB transmission, infection prevention control measures, respiratory protection and the usage and adherences of the N95 respirator mask was discussed in detail. Researched articles were collected from different sources and the information collected was used to address the objectives of the study. Several studies were reviewed to find out about the risk of TB transmission in the

healthcare settings and the community. The levels of TB infection prevention and control measures applied were discussed in the healthcare settings.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

In this chapter the research design, population and sample, research setting and data collection are described. The design and method were selected to quantify the adherence to and the usage of the N95 respirator mask by the healthcare professionals and healthcare workers during the management of suspected or confirmed TB infected patients in the TB settings. This chapter also describes the reliability and validity of the research instrument, the pilot study and ethical principles considered in respect of the science of research and the use of human participants.

3.2 Research Design

A cross-sectional, descriptive survey design was used to collect the data. 'Cross-sectional' describes a design conducted in the present time to examine what currently exists (Brink, 2002:10). In this type of design the researcher selects a population and studies the identified variables at one time, to determine the outcomes (Brink, 2002). In this study a descriptive study design thus provided a description of variables in order to answer the research question, to obtain complete and accurate information about the use of the N95 respirator through observation description and classifications. This study focused on healthcare professionals' reported practices when using the N95 respirator mask.

3.3 Research Methods

3.3.1 Sample size

For the purpose of this study there were a total of 204 healthcare professionals and healthcare workers (N=204) who worked in five healthcare facilities (N=5) in the Tshwane district. These two population sets also formed the target population from which the study sample was obtained.

3.3.2 Study sample

Assuming 20% level of non-adherence, 5% precision and 95% confidence interval, the estimated minimum sample required was 148 (n=148). The sample size was inflated by 25% to take into account non-response, which amounted to 157 participants (n=157) required. For sample adequacy, all healthcare professionals and healthcare workers (N=370) working in five healthcare facilities in the Tshwane district were invited to participate in the study.

3.3.3 Inclusion criteria

Participants were subjected to the following inclusion criteria:

- Participants had to belong to either category of staff: nurses (all categories), physiotherapists, doctors, clerks and general workers

- Healthcare professionals and workers must have been employed for a minimum of six months in TB settings

3.4 Data Collection

Self-administered questionnaires were delivered to all 370 healthcare professionals and healthcare workers, at their places of work between 08h00 and 16h00 daily, from Monday to Friday, over a two month period. A total number of 204 questionnaires were completed and returned, which gave a 55% response rate. This constituted the final sample (n=204). A 26-item self-administered questionnaire (Annexure A) was used to collect data to determine the adherence to and use of the N95 respirator mask as reported by healthcare professionals (doctors, nurses and physiotherapists) and healthcare workers (clerks and general workers). Questionnaire items were derived from CDC infection prevention and control manuals and OHSA policy guidelines to ensure content validity.

The questionnaire comprised the following sections:

Section A- Biographical data such as professional category, qualification of participants and years of experience in TB care and the type of facility were obtained in this section for the purpose of meeting the first study objective.

Section B- This section comprises 13 items derived from OHSA policy guidelines on the respiratory protection programme and medical evaluation prior to the use of the N95 respirator mask and fit testing.

Section C- This last part comprised 9 items that elicited data on health workers' practices when using the N95 respirator mask to determine their adherence.

The researcher personally delivered questionnaires to the clinics and hospitals in the Tshwane district. Participants received an information sheet (Annexure E) two days before the data collection, to give them time to read and ask questions if needed. Questionnaires were handed to participants in a sealed envelope. The researcher introduced the questionnaires and explained the purpose of the study to the participants before they completed the questionnaires. The researcher read and explained the questionnaire to the participants to overcome misunderstanding. Participants were given enough time to read the information sheet and ask questions for clarity. Participants completed the questionnaires anonymously and each participant was provided with an envelope to be sealed after inserting the questionnaire. After completing the questionnaires, participants posted all of them in a big brown envelope for the researcher to collect. Data collection continued until the desired sample size was achieved.

3.5 Research Setting

Data was collected in a TB setting treatment room or ward used by suspected or confirmed TB patients; the rooms or wards were usually well ventilated (mechanical or natural). Natural ventilation is the movement of air in a building and replaces air in a building with air from the outside; natural ventilation relies on open doors and windows. Mechanical ventilation depends on the usage of propeller fans and mechanical air mixture. The windows and the doors were opened to encourage natural ventilation in the building or dilution of air inside build area. Ultra Violet

Germicide Irradiation (UVGI) lights were installed and were working continuously (CDC 2005:235-239).

3.6 Reliability and Validity of the Instrument

Validity refers to measurement of data as it will be used to answer the research questions or the degree to which a research instrument measures what it intends to measure (Brink, 2002). To ensure content validity instrument items were derived from OHSA policy guidelines, CDC infection prevention and control manual and transformed into close and open-ended questions. The questionnaire was also given to experts to review for accuracy of content. Again the questionnaire was given to the Gauteng Department of Health Infection Control Directorate and the University School of Pathology to check for fact and content clarity and relevance of items.

Reliability refers to the degree of constancy, stability or repeatability of an instrument to measure the attributes it is designed to measure. The questionnaire was tested on a sample of fourteen (n=14) healthcare professionals and healthcare workers. The purpose was to identify the response rate and to identify potential problems, time taken to complete the questionnaire and to check whether data addresses the objectives of the study. Test-retest method was used to determine the accuracy and internal consistency of the questionnaire. The same questionnaires was retested two weeks later on same sample of fourteen (n=14) healthcare professionals and healthcare workers. The scores from the first 14 questionnaires were compared to the second set of scores obtained. The correlation reliability (r-value = 0.8) obtained. The acceptable r-value is any number

"between" 0.8 to 1.2. The number that represents the correlation can range from -1.00 to +1.00 (Brink, 2002).

3.7 Pilot Study

A pilot study was conducted to investigate the feasibility of the proposed study through detecting the possible flaws in the data collecting instruments. This involved a small scale study which was conducted before the main study on a limited number of subjects from the same population (Brink, 2002). A self-administered questionnaire was piloted on a sample of fourteen (n-14) healthcare professionals and healthcare workers in five (n=5) healthcare facilities in the Tshwane district; pilot study questionnaires were distributed according to the size and number of population per facility, the format of distribution was as follows 4, 4, 3, and 3 per facility. Healthcare professionals and healthcare workers who participated in the pilot study are not included in the main study. A sample of four (n=4) healthcare professionals and healthcare workers were invited from the healthcare facility attended first, the questionnaire was repeated to another sample of (n=4) healthcare workers from the other facility and so on, until the whole total sample of fourteen (n=14) healthcare professionals and healthcare workers was completed. Repeatability and test-retest method followed for the accuracy of the questionnaire even during the pilot study. The researcher availed himself to the pilot study group in order to assist and clarify any difficulties, and to answer any questions that could arise from the pilot study group. During the completion of the questionnaires, the pilot study group was observed for any problems or difficulties experienced in completing the questionnaires. The time taken to complete the questionnaire was also observed.

The repeated pilot study group did not have literacy problems; the questionnaires were completed within the 30 minutes time allocated, and there was consistency in answering the questionnaire.

3.8 Data Analysis Plan

3.8.1 Data capturing

Data was captured in Microsoft Excel 2007 spreadsheet software. Quality control measures were implemented during the data entry process to avoid the capturing of extreme values. The data was cleaned in Ms-Excel and those who had missing data were coded as "Missing". Data on staff category, age-group, years of work experience and type of facility was categorised for analysis purposes. Data was then imported to STATA version 10 for analysis.

3.8.2 Data analysis

Descriptive analysis was done to describe the sample, the results of the study. For categorical variables, frequencies and percentages were computed. The findings were presented in frequency tables, bar graphs and pie charts. Cross tabulation of healthcare professionals and workers according to their categories, qualifications and years of experience against adherence to policy and usage of the N95 respirator mask was done.

3.9 Ethical Considerations

The study was approved by the Higher Degrees Committee of the Faculty of Health Sciences (Annexure B). Ethical clearance was obtained from the Human Research Ethics Committee of Wits University (Annexure C). Permission was also obtained from the Gauteng Department of Health, Human Research Ethical Committee after written request from the Human Resource manager (Annexure D). An information sheet (Annexure E) was given to participants to ensure that they were fully informed about the voluntary nature of participation in the study. Healthcare professionals and healthcare workers were invited to participate; a completed questionnaire was considered as consent to participate. Participants were informed that they could withdraw from the study without any penalty, should he/she wish to discontinue at any point. To ensure confidentiality and anonymity of the participants, codes were used during data processing and reporting. No name or any other identifying characteristics were used or referred to during the study

3.10 Conclusion

The research design and methodology was discussed in detail in this chapter. Validity and reliability of the data collecting tool as well as the ethical considerations of participants applied throughout the study was described. Chapter four presents the data analysis and results of the study.

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

4.1 Introduction

The general descriptive analysis of all the study variables will be described in this chapter. This chapter also looks at the respiratory protection policy and the frequency of medical difficulties with the respirator before the introduction of the N95 respirator mask. It then looks at the implementation of fit testing in the health facilities.

4.2 General Description of Study Participants

A total of 204 healthcare professionals and healthcare workers working in five healthcare facilities in the Tshwane health district met the inclusion criteria for this study. The majority of the study participants fell in the age groups 31-40 and 41-50 years. More than 83.3 % (n=170) of the staff were nurses; physiotherapists in the healthcare facility constituted the lowest percentage (1.9%; n=4). More than half (54.4%; n=111) the healthcare professionals and workers had 6 months to 5 years work experience in the healthcare facility. The majority (65.5%; n=134) of the healthcare professionals and healthcare workers work in a hospital setting. Almost half (49.2%; n=100) of the healthcare professionals and healthcare workers indicated that they have isolation rooms in the healthcare facilities, whereas 80. 33 %(n=165) indicated that they have infection prevention and control teams. Refer to **Table 4.1.**

Table 4.1: **Descriptive analysis of 204 study participants from five healthcare facilities in the Tshwane health district (n=204)**

Variable	N	%	Frequency(f)
Demographics			
Age	204		
20-30 years		15.20%	31
31-40 years		31.86%	65
41-50 years		32.35%	66
>50 years		20.59%	42
Staff category	204		
Nurses		83.33%	170
Physiotherapists		1.96%	4
Doctors		2.45%	5
General workers		8.33%	17
Clerks		3.92%	8
Work related			
Work experience	204		
6 months - 5 years		54.41%	111
6 – 10 years		16.18%	33
11 – 15 years		7.35%	15
16 – 20 years		12.75%	26
21 – 25 years		5.39%	11
>25 years		3.92%	8
Type of facility	204		
Hospital		65.69%	134
Clinic		32.35%	66
Missing		1.96%	4
Isolation rooms	204		
Yes		49.02%	100
No		42.65%	87
Missing		8.33%	17
Infection prevention control team	204		
Yes		80.88%	165
No		6.86%	14
Don’t know		12.25%	25

Figure 4.1 illustrates the proportion of facilities with a written respiratory protection policy. A total of 63.72 %(n=130) responded to the question, 46 % (n=95) reported that the facility has a written respiratory protection policy, whereas the 22 %(n=44) reported the absence of a written respiratory protection policy in the facility.

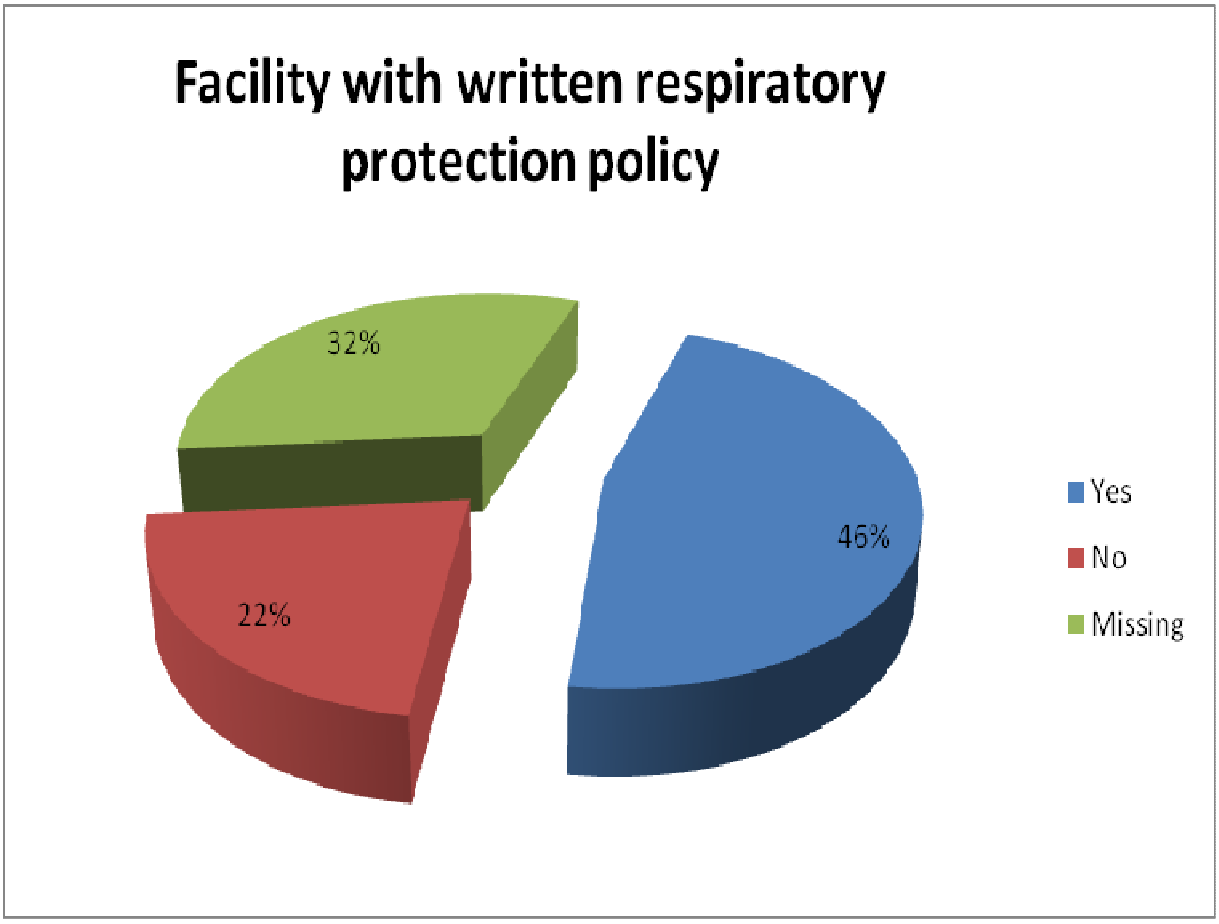

Figure 4.1: Facilities with written respiratory protection policy (n=204)

Figure 4.2 illustrates the attendance in healthcare facilities during the respiratory protection policy training. Approximately two thirds (65.7%; n=134) of the healthcare professionals and healthcare workers reported that they did not attend the respiratory protection policy training, whereas 3 %(n=7) did not indicate whether they attended the training or not.

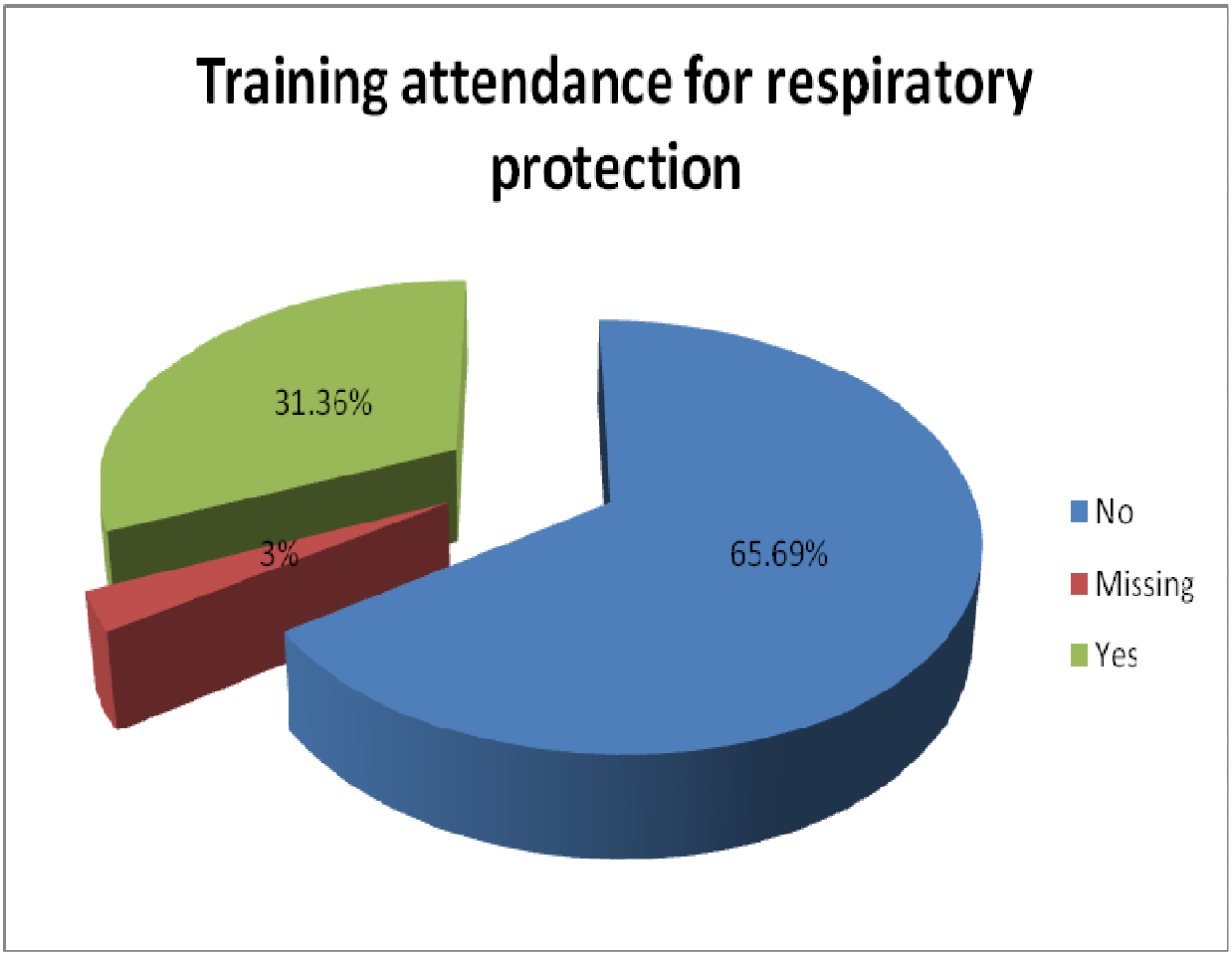

Figure 4.2: Training attendance for respiratory protection (n=204)

Figure 4.3 illustrates the healthcare professionals' and healthcare workers' report on the provision of respiratory protection guideline during their training. Approximately a quarter of the

respondents indicated that the respiratory protection guideline was provided during training whereas majority (44.12%; n=91) of them were not sure whether the guidelines were provided.

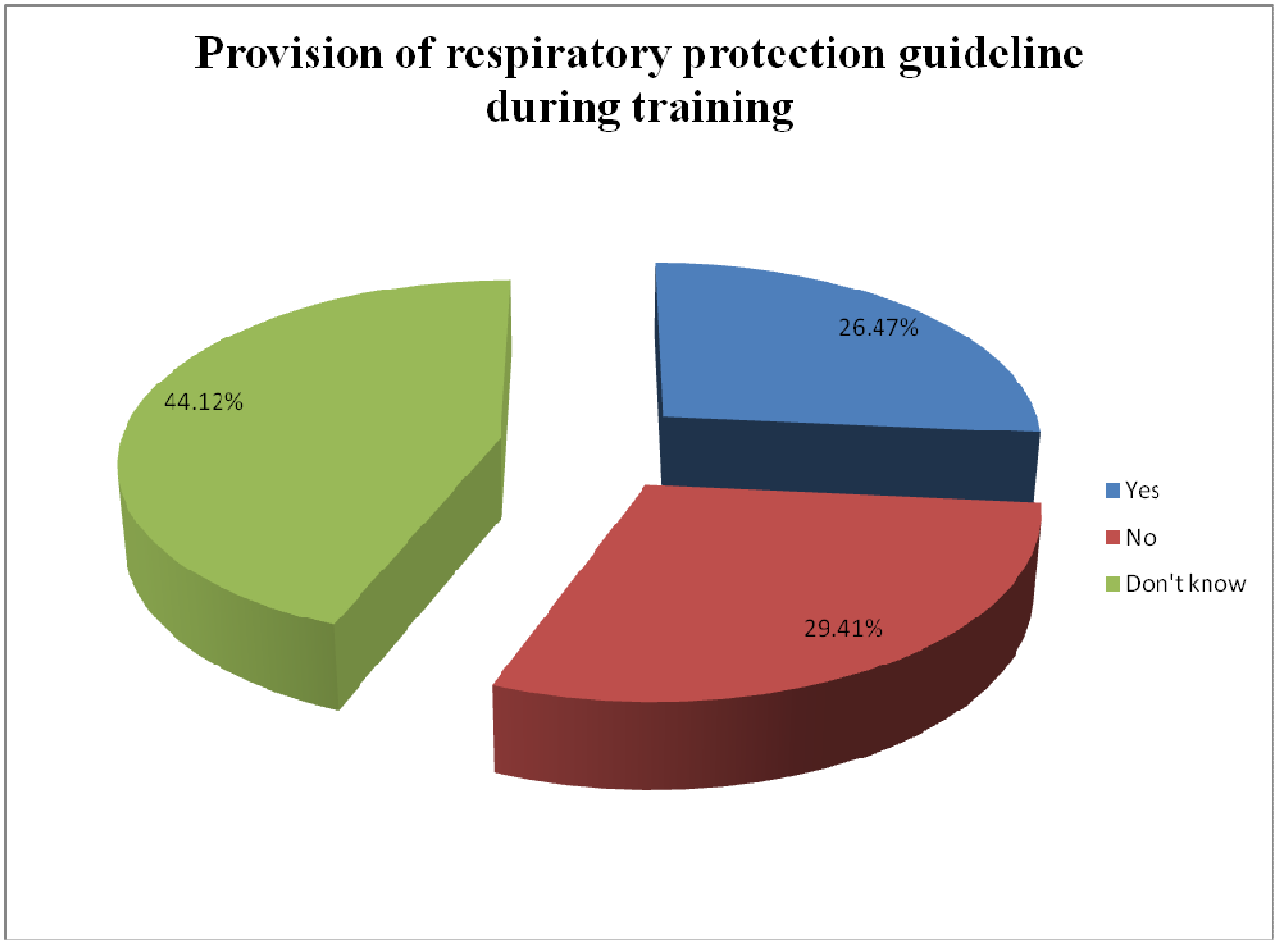

Figure 4.3: Provision of respiratory protection during guideline during training (n=204)

Figure 4.4 illustrates the percentage of healthcare professionals and healthcare workers who followed the template guidelines. The majority (40.20%; n=83) of them did not indicate whether they followed the guideline template (missing), whereas 21.6 %(n=45) indicated that they followed the guideline template.

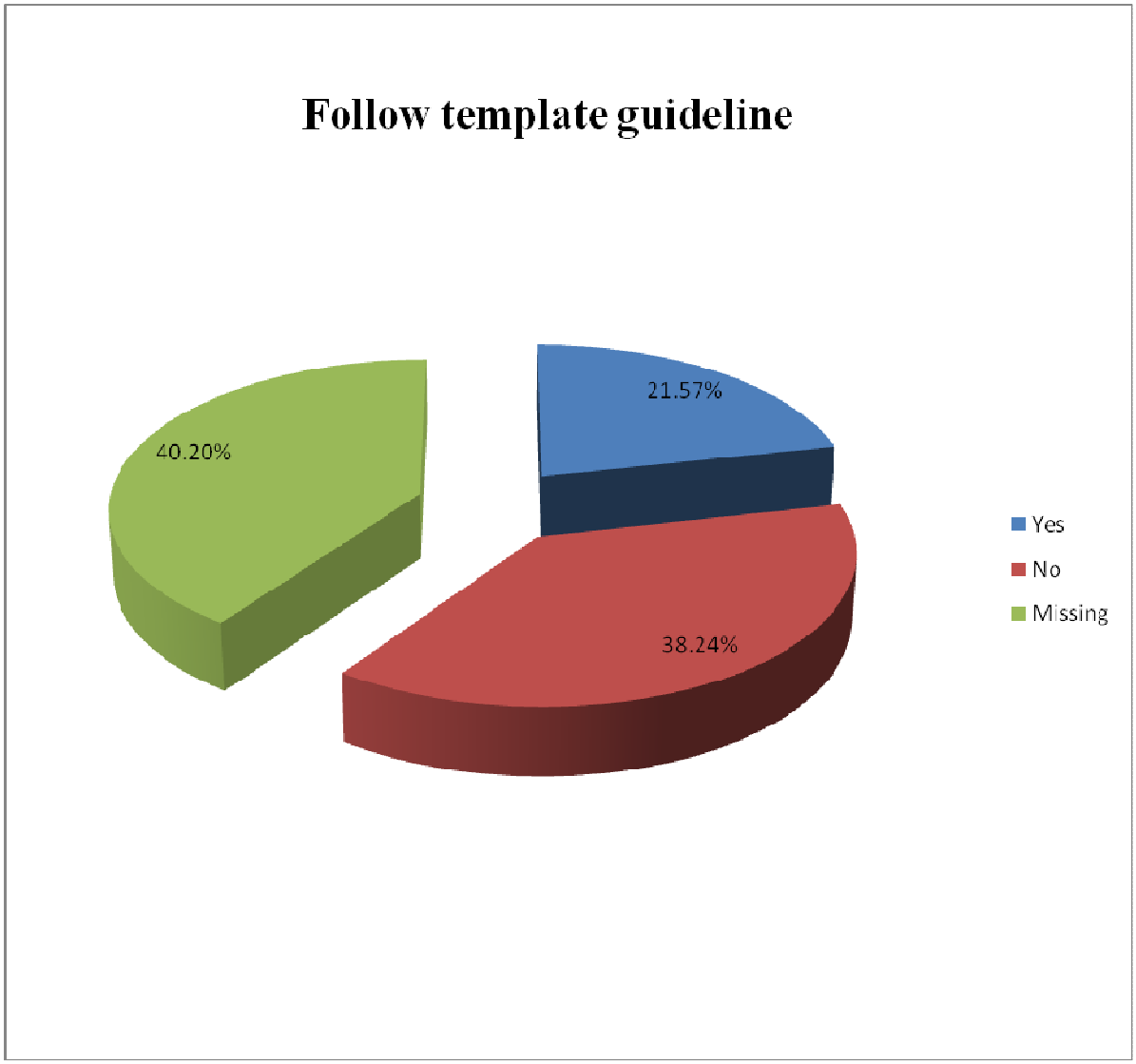

Figure 4.4: Participants followed template guideline (n=204)

Figure 4.5 illustrates the extent of implementation of the respiratory protection programme at the workplace. When participants were asked whether the respiratory protection programme was designated at their workplaces, almost half (48. 4%; n=99) of the healthcare professionals and healthcare workers were not aware that the respiratory protection programme was designated at

their workplace, whereas 26.5 %(n=55) of them reported that the respiratory protection programme was designated at their workplaces.

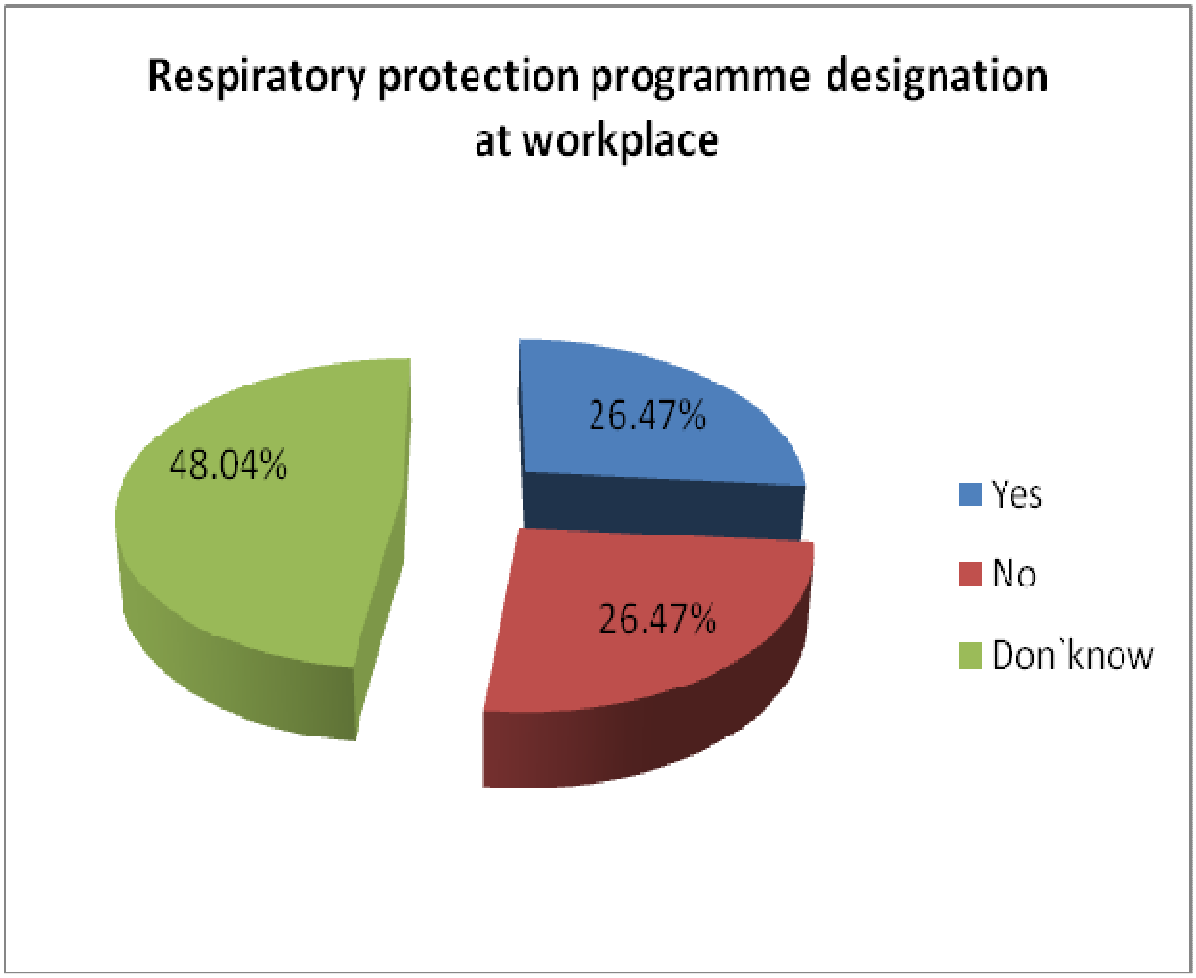

Figure 4.5: Respiratory protection programme designation at workplace (n=204)

Designating a programme administrator for respiratory protection programme must be timed according to the training session conducted for healthcare professionals and healthcare workers. **Figure 4.6** demonstrates when the programme administrator for respiratory protection was designated to healthcare professionals and healthcare workers. Approximately two thirds of the

healthcare professionals and healthcare workers did not respond to this question. 3.9 %(n=8) reported that they received prior training and revised after training.

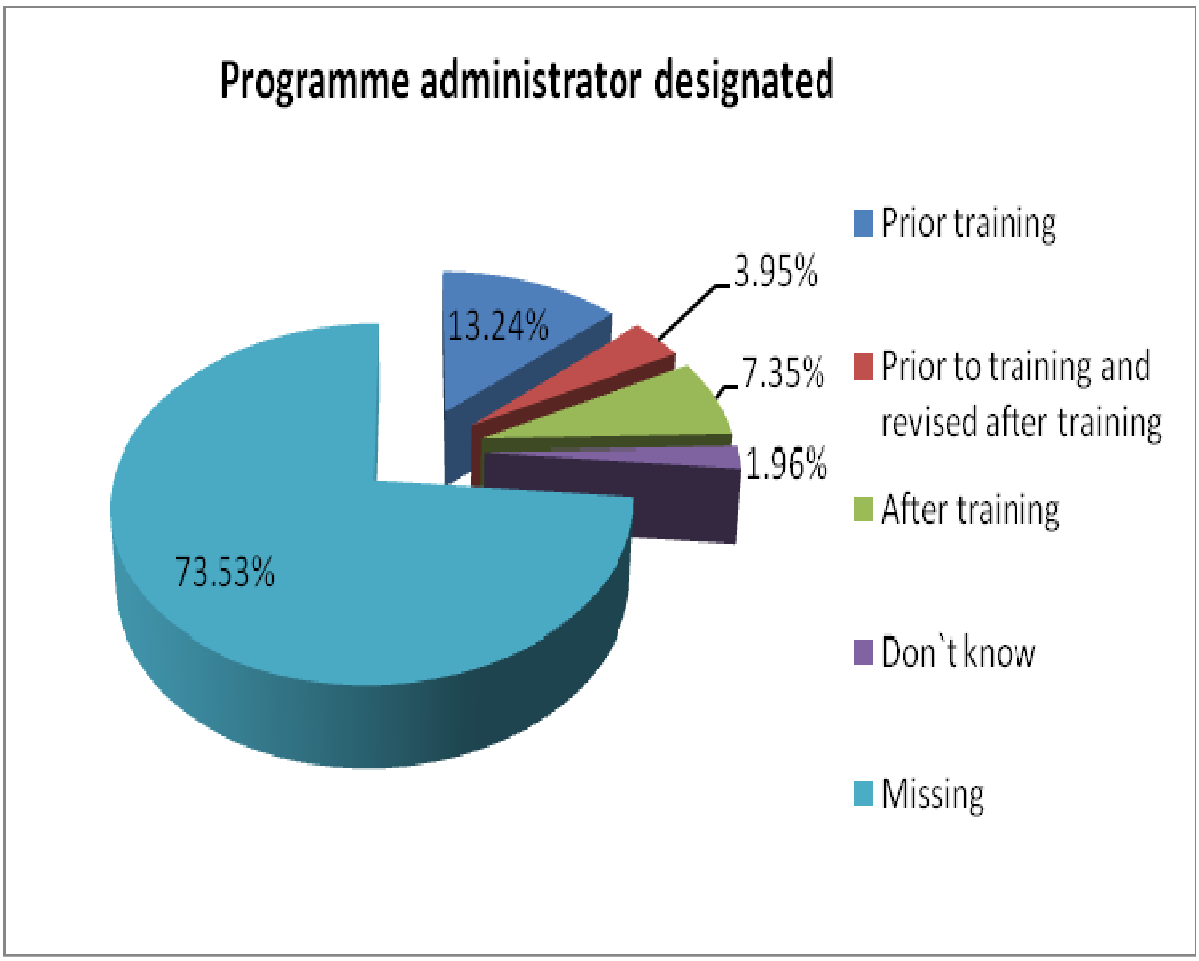

Figure 4.6: Designation of programme administrator in relation to training (n=204)

4.3 Medical Evaluation According to the Occupational Health and Safety Act

The Occupational Health and Safety Act (OHSA) require healthcare professionals and healthcare workers to undergo medical evaluation before they are permitted to wear the N95 respirator mask. **Table 4.2** illustrates the extent to which the OHSA requirements were met among healthcare

professionals and healthcare workers in the five healthcare facilities in Tshwane district. The majority of the respondents (65.69%; n=134) indicated that they did not undergo medical evaluation for potential medical difficulties before they were permitted to wear the N95 respirator mask, whereas 17.16 %(n=35) indicated that they were evaluated. Training of healthcare professionals and healthcare workers with regard to fit testing of the N95 respirator mask before they are permitted to wear it is a requirement of the OHSA. This study indicates that 6 %(n=12) of the respondents went through training prior to using the respirator, however the majority (84.8%; n=173)) of the respondents did not respond to this question. According to the OHSA, all healthcare professionals and healthcare workers are required to undergo fit testing before they are permitted to wear the N95 respirator mask. When the respondents were asked if there was any employee in their facility who was trained on how to perform fit testing, 35.78%(n=73) of them indicated that there was no one trained whereas 21.57%(n=44) indicated that they had people who were trained. With reference to the timing of fit testing in relation to training sessions participants were asked about the commencement of the fit testing of the N95 respirator mask, 11.76%(n=24) indicated that they commenced prior to training and 13.73%(n=28) commenced after training.

Table 4.2: Medical evaluation of the N95 respirator mask (n=204)

Variable	n	%	frequency(f)
Medical difficulties with respirator before the introduction of N95 mask	**204**		
Yes		17.16%	35
No		65.69%	134
Don't know		17.16%	35
When underwent medical evaluation for medical difficulties with respirator use	**204**		
Prior to training session		5.88%	12
Prior to training and revised after training		1.47%	3
After training session		6.86%	14
Don't know		0.98%	2
Missing		84.8%	173
Fit testing			
Employee at work with fit test training			
Yes	**204**	35.78%	73
No		21.57%	44
Don't know		42.65%	87
Were they trained by the OHS hygienist			
Yes	**204**	25.98%	53
No		22.06%	45
Don't know		51.96%	106
Provision of fit testing before wearing a respirator mask			
Yes	**204**	27.94%	57
No		52.94%	108
Don't know		19.12%	39
Commence of fit testing			
Prior to training session	**204**	11.76%	24
Prior to training and revised after training		2.94%	6
After training session		13.73%	28
Don't know		1.96%	4
Missing		69.61%	142
Evaluate good fit of the N95 respiratory mask			
Good	**204**	21.57%	44
Poor		57.35%	117
Missing		21.08%	43

4.4 Practices When Using the N95 Respirator Mask

This section elicited the detail about wearing, maintenance, disposal and level of adherence to the usage of the N95 respirator mask by healthcare professionals and healthcare workers in TB healthcare settings. Multiple-choice types of questions were used to assess participants` knowledge in relation to when the N95 respirator mask should be worn. Four possible answers were given to participants to choose from, participants could also choose more than one option. Questions were as follows (codes were allocated to answers for statistical analysis).

- A- All the time within a shift
- B- When entering an isolation room
- C- When transporting a suspected or confirmed TB patient
- D- When in contact with an unmasked active patient

One third (33%; n=77) of the participants indicated that they should wear the mask when entering an isolation room, transporting a suspect or confirmed TB patient and when in contact with an unmasked active TB patient. Approximately 14 %(n=33) of the respondents indicated that the N95 respirator mask should be worn constantly within a shift. Refer to figure 4.7

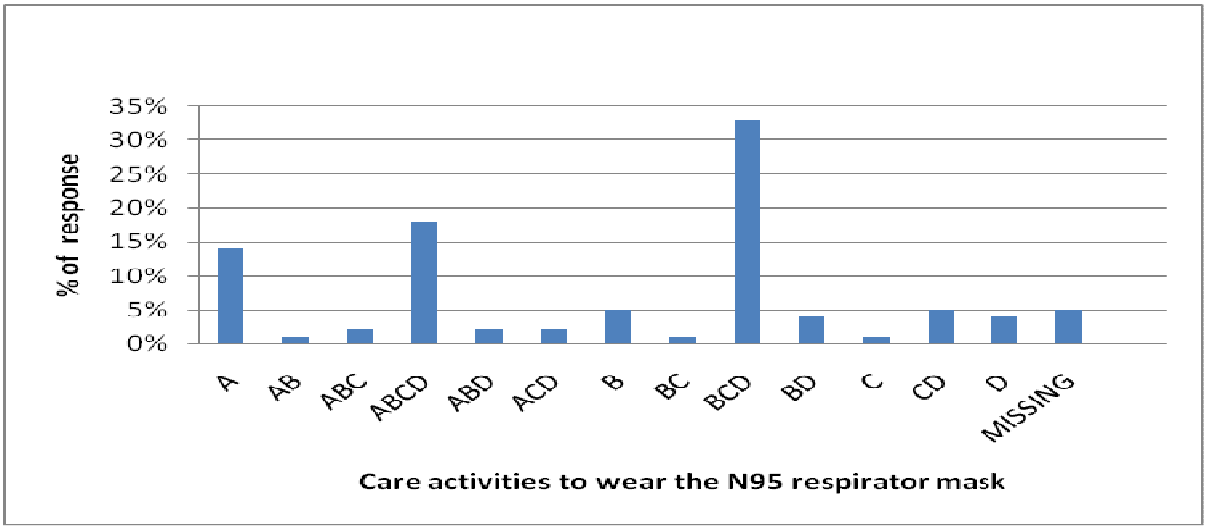

Figure 4.7 Activities during which participants wear the N95 respirator mask (n=204)

Chi-square test was done to test whether there was a significant difference between knowledge on the fit-test of the N95 respirator mask and the category of healthcare professionals and healthcare workers. **Table 4.3** indicates that there was no significant difference in knowledge across the five staff categories P-value of >0.05.

Table 4.3: Association between participants' knowledge of fit test of the N95 respirator mask (n=204)

Staff category	Knowledge	No Idea	Missing	Chi-square	P-value
Nurses	42(24.7%)	92(54.1%)	36(21.2%)	9.20	0.33
Physiotherapist	1(25%)	3(75%)	0		
Doctors	1(20%)	3(60%)	1(20%)		
General worker	0	13(76.5%)	4(23.5%)		
Clerk	0	6(75%)	2(25%)		

4.5 Care, Maintenance and Disposal of the N95 Respirator Mask

Figure 4.8 demonstrates participants' category reports on the disposal of the N95 respirator mask in their facilities. The majority (70%; n=143) of participants reported that the disposal of the N95 respirator mask is treated as a health risk waste in their facilities.

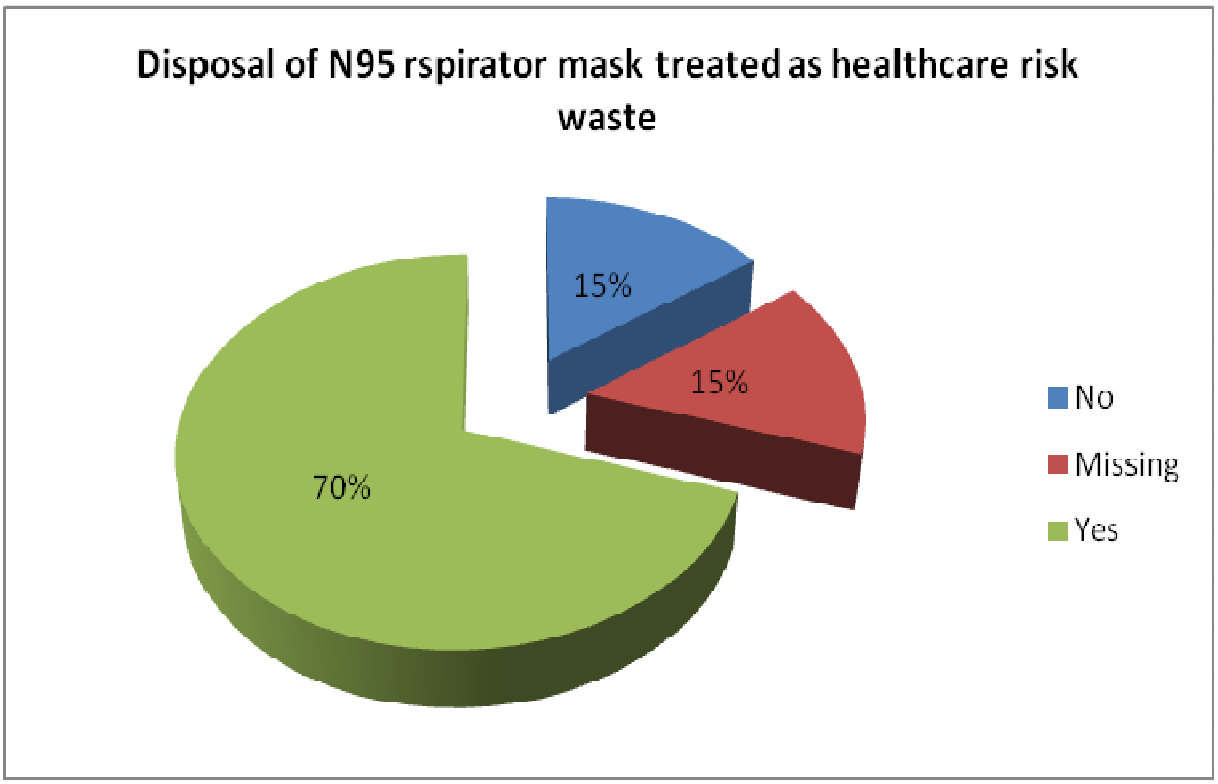

Figure 4.8 Disposal of the N95 respirator mask treated as healthcare risk waste (n=204)

4.5.1 Participants' rating of overall adherence to the correct usage of the N95 respirator mask

The health professionals and workers were asked to rate the overall adherence to the correct usage of the N95 respirator mask by the co-workers (doctors, nurses, physiotherapist, general workers

and clerks) in the TB settings during the management of patients with suspected or confirmed TB infection. Almost half (44.1%; n=90) of respondents rated clerks as not adhering to the correct usage of the N95 respirator mask; 38.2% (n=78) of respondents rated nurses partially compliant. Between 22% and 23% of respondents chose not to report on their co-workers' compliance. This is shown as missing data (n) below. Refer to **Table 4.4**.

Table 4.4: Participants' rating of overall adherence to the correct usage of the N95 respirator mask (n=204)

Staff category	Adherence	Partial adherence	Non-adherence	Missing (n)
Doctors	54(26,5%)	54(26,5%)	27(13,2%)	69
Nurses	60(29,4%)	78(38,2%)	20(9,8%)	46
General workers	25(12,3%)	74(36,3%)	59(28,9%)	46
Physiotherapists	46(22,6%)	51(25%;)	45(22.1%)	62
Clerks	10(4,9%)	51(25%)	90(44,1%)	53

4.2 Conclusion

In this chapter data were analyzed and results presented. Each section and items of study questionnaire were analyzed and described in detail. The questionnaire items were dealt with one by one until they were completed, so that the objectives of the research study could be met. Statistical computer programme (Epi info version 3.1.3. 13/ 2008) was applied for the accuracy of the study results. Frequency tables were used to describe participants` level of adherence to the

usage of the N95 respirator mask. The next chapter will discuss the main findings, recommendations, limitations and conclusion of the study.

CHAPTER FIVE

DISCUSSION OF FINDINGS, RECOMMENDATIONS, LIMITATIONS AND CONCLUSION

5.1 Introduction

In the previous chapter the results were presented according to the sections of the study questionnaire. In this chapter, the main findings, recommendations, limitations and conclusions of the study will be discussed. The results are discussed in relation to the objectives of the study, so that appropriate conclusion and recommendations can be made. Recommendations are made with reference to the findings of the study. The recommendations made focus on the improvement of infection control measures in relation to the adherence to and usage of the N95 respirator mask during the management of a patient with suspected or confirmed TB infection in healthcare facilities in the Tshwane district.

5.2 Discussion of Findings

The purpose of the study was to determine the adherence to and usage of the N95 respirator mask as TB control measures in healthcare facilities in the Tshwane district during managing a patient suspected or confirmed with TB infection. A 26-item self-administered questionnaire was used to collect data in relation to the following objectives:

5.2.1 Demographic and work profile

It was important to present the summary of demographic and work profile, as it shows the numbers and categories of participants, age category, work experience as well as the type of the facilities they worked in at the time of the study. It made it easy for the researcher to understand and to assess which staff category among healthcare professionals and workers were more exposed to suspected or confirmed TB infections in the TB settings. This study showed that, out of the 204 healthcare professionals and healthcare workers who responded in the study, the majority (83.33%) participants were nursing staff, whereas physiotherapists in the healthcare facility constituted the lowest percentage (1.9%). Nursing staff are the majority in the healthcare facilities than other categories of staffs. Shimouchi, Hirota, Kota and Mui (2007) reported that, one of the activities that expose a risk of development of TB in the work place in Japan is nursing care management of patients with suspected or confirmed TB infections. Most participants fell in the age groups 31-40 (31.86%; n=65) and 41-50 (32.35; n=66) years. More than 50% of the healthcare professionals and workers had six months to five years of work experience in the healthcare facility. The majority (65.5%; n=134) of the healthcare professionals and healthcare workers work in a hospital setting.

With reference to isolation rooms, almost half (49%; n=100) of the participants reported that their institutions had isolation rooms. Since M. tuberculosis is carried in airborne particles, when a person who has pulmonary or laryngeal TB diseases coughs, sneezes or shouts, M. tuberculosis particles of approximately 1-5µm remain spread throughout a room for some time. Thus, persons entering the room stand a high risk of inhaling floating droplets of nuclei containing M. TB. Patients with suspected or confirmed TB disease should be placed in airborne infection isolation

rooms. It is the requirement for healthcare facility managing patients with suspected or confirmed TB diseases to have airborne infection isolation room (Nakajima and Mori, 2001). Moreover, healthcare facilities are required to have a fully functional infection prevention and control (IPC) multi-disciplinary team. This team is responsible for compliance, implementation and reviewing of IPC policies. The majority (80.88%; n=165) of participants reported that their institutions had an infection prevention and control team.

5.2.2 Implementation of the respiratory protection programme

The second objective of the study was to determine the implementation of the respiratory protection programme for infection prevention and control. Almost half of the participants (48%) did not know that, there was designated respiratory protection programme in their place of work. The implementation of the respiratory protection is mostly focused on protecting employees against exposure to TB infection in the healthcare facilities during the management of suspected or confirmed TB patients. Results on implementation are discussed according to OHS policy and administration, medical evaluations and fit testing.

5.2.2.1 OHS policy and administration

OHS policy and administrative data are an indicator of the effectiveness of control measures in place to ensure that the healthcare professionals and workers are not overexposed during management or curing of TB patients in the TB healthcare settings. Healthcare professionals and healthcare workers managing patients suspected or confirmed as having pulmonary TB infection

are required to wear the N95 respirator mask in the TB settings (South African National Tuberculosis Guideline, 2009). The South African Occupational Health Safety Act, 85 of 1993 (OHSA) requires that the entire TB healthcare settings implement TB the respiratory protection programme for the safety of healthcare professionals and workers. The administration programme is all about preventing healthcare professionals and workers from being exposed to TB infection and reducing the spread of TB infections by:

- Developing and implementing policies in the healthcare facilities
- Monitoring and evaluating the implemented standards
- Developing staff training programmes
- Development of respiratory protection template (guideline) for training

The training includes the adherences, usage and the correct selection of the N95 respirator mask and the instruction on how to do proper fit testing and medical evaluation of personnel. The literature review in chapter two emphasises the need for training of healthcare professionals and workers on fit testing and usage of the N95 respirator mask. The results analysed have showed that, most of participants (46%; n=95) reported that their facilities have written respiratory protection policy. Approximately two thirds (73.53%; n=151) of the healthcare professionals and healthcare workers reported that they had not attended the respiratory protection policy training. Only a small portion (13.24%; n=28) of participants attended the training, whereas 1.9%(n=5) did not indicate whether they attended the training or not, of those who attended the training approximately a quarter (26.47%;n=45) of the respondents indicated that the respiratory protection guideline (template) was provided during training, and 29.41%(n=77) respondents reported that respiratory

protection guideline (template) was not provided during the training sessions. Most participants (44.1%; n=83) were not sure whether the guidelines were provided or not. These results give a clear indication that the OHSA and the administration of respiratory protection policy have been neglected as protective measures for healthcare professionals and healthcare workers during the management of TB patients. It remains the responsibility of the infection prevention and control team to ensure that standard infection prevention and control policies are implemented and that healthcare facilities are complying (CDC, 2010). Infection prevention and control team is responsible for the following.

- Making sure that policies are implemented and are accessible to all healthcare staff
- Required facilities and equipment are available to enable compliance with the policies
- All clinical staff within their area of responsibility have received relevant training
- Conduct infection prevention and control audited and recommend.
- Reviewing policies and amendments according to current National, Provincial professional standards

5.2.2.2 Medical evaluations

Given that healthcare professionals and healthcare workers may experience breathing difficulties when wearing the N95 respirator mask, OHSA requires that all healthcare professionals and healthcare workers undergo medical evaluation before they are permitted to wear the N95 respirator mask. The study by Research and Education Unit (2005) in California recommends that employers must provide their healthcare professionals and workers with medical evaluation before

they are permitted to wear the N95 respirator mask. Medical evaluations must be performed before fit testing the N95 respirator mask, or when healthcare professionals and healthcare workers wear the N95 respirator mask for the first time. South African National Tuberculosis Guideline (2009) also requires healthcare facilities to implement policies on medical evaluation to all healthcare professionals and workers, before they are permitted to wear the N95 respirator mask during the management of patients suspected or confirmed with TB infection. Respirators are used to protect and prevent the wearer from inhaling M.TB airborne particles although as mentioned earlier, they can aggravate several physiological stresses on the wear especially the pulmonary and cardiac system (Szeinuk, Beckett, Clark and Hailoo, 2000). It is therefore important for healthcare professional and healthcare workers to undergo medical evaluation for potential medical difficulties before they are permitted to wear the N95 respirator mask. The majority of the participants (65.69%; n=134) who participated in the study indicated that they did not undergo medical evaluation for potential medical difficulties before they were permitted to wear the N95 respirator mask, whereas 17.16% (n=35) indicated that they were evaluated. This result indicates poor compliance to the implementation of OHSA policies by most of healthcare facilities in the lines of management of suspected or confirmed TB infected patients. It was evident that such policies are not implemented in most facilities.

5.2.2.3 Fit testing

Fit testing is required before healthcare professionals and healthcare workers use the N95 respirator mask during the management of patients suspected or confirmed TB infection. To achieve the highest level of respiratory protection during the management of suspected or confirmed TB infected patients, healthcare professionals and healthcare workers must have the

knowledge of how to correctly fit the N95 respirator mask (CDC, 2010). The majority of participants (57.37%; n=117) reported not having the knowledge of how to check a good fit testing of the N95 respirator mask. The results thus indicate that majority of the healthcare professionals and workers do not have the knowledge of performing good fit testing of the N95 respirator mask. This implies that the healthcare professionals and workers are not adequately protected against TB infection during the management of patients with suspected or confirmed TB infection in the TB settings. The healthcare facility must allocate a qualified OHS hygienist to train healthcare professionals and healthcare workers, on how to do good fit testing before they can use the N95 respirator mask. The purpose of the fit testing is to identify the specific make, model, style and size of the N95 respirator mask that is best suited for the healthcare professional and healthcare workers (Research and Education Unit, 2005).

5.2.3 Practices when using the N95 respirator mask

Adherence to the usage of the N95 respirator mask is the key variable in this study. The results showed that participants have the knowledge regarding the usage of the N95 respirator mask when managing suspected or confirmed TB patients. When participants were asked about the activities during which they wear the N95 respirator mask, one third (33%;n=77) of the participants indicated that they should wear the mask when entering an isolation room, transporting a suspect or confirmed TB patient and when in contact with an unmasked active TB patient. Approximately 14%(n=33) of the respondents indicated that the N95 respirator mask should be worn full time within the shift. They further indicated that patients are provided with surgical masks. Essentially, all suspected or confirmed TB patients who cough or sneeze should be provided with the surgical mask. With regards to disposal, majority of participants (56%;n=113) reported that their facilities

have written policies for discarding and safe disposal of the N95 respirator mask. On the other hand the majority (82%; n=166) of the participants also indicated that the disposal of the N95 respirator mask is treated as a healthcare risk waste. This result indicates that the majority of the facilities are adhering to good practices including the disposal of the N95 respirator mask.

TB transmission may occur when suspected or confirmed TB infected patients are not promptly identified and preventative measures are not put in place. To ensure the safe use of the N95 respirator mask, the healthcare facility must have a written respiratory protection programme policy with specific conditions for the workplace and must be adhered to by everyone working in the TB settings (Research and Education Unit, 2005). Adherence and compliance to the respiratory protection programme in the TB setting can be highly beneficial. The Centre for Disease Control and Prevention emphasises that strict implementation of respirator protection programme in the healthcare setting will greatly reduce the exposure of healthcare professionals and healthcare workers to airborne infections, serious illness or death. In addition, high level of training and experience is needed to execute an effective respiratory protection programme. The respiratory protection programme will depend on the complexity of healthcare setting, type of patients, their infectious status and type of N95 respirator mask (CDC, 2010). The study also found that there was no significant difference between the knowledge of N95 and the actual usage of the N95 across the five categories of health workers, P-value of >0.05.

5.3 Limitations

There were some limitations to this study; one of the limitations is that the researcher collected the age category and years of experience in groups (categorical data) therefore the mean and standard deviation of these two variables cannot be computed. There was scanty information in most of literature articles studied in relation to the adherence, usage and handling of the N95 respirator mask. Limited information in the literature studied made it difficult for the researcher to gather more information and to discuss the study results in this context.

5.4 Recommendations

The study showed that there were several problems in the adherence to and the usage of the N95 respirator mask in healthcare settings. The recommendations focus on the improving the adherence to and usage of the N95 respirator mask in healthcare facilities in the Tshwane district and reducing the risk of M-TB transmission to healthcare professionals and workers during the management of suspected or confirmed TB patients in the TB settings. The recommendations made below were based on the findings from this study.

5.4.1 General recommendations

It is recommended that the Department of Health compile a specific policy and standard operational procedures for the usage of the N95 respirator mask as the TB control measure; and that such policy must be made compulsory to all the healthcare facilities. To intensify the

monitoring of companies who are in tender with the Department of Health, which are manufacturing and supplying the N95 respirator masks to the healthcare facilities (hospitals and clinics). Companies that are on tender must have the OHSA certificate that permits them to manufacture or to supply N95 respirator masks. This will ensure a standardised type of N95 respirator masks to be used by healthcare professionals and workers in the TB healthcare settings.

A fit testing check should be performed each and every time when the N95 respirator mask is worn, personnel should not be allowed to enter or to manage suspected or confirmed TB patients until a satisfactory fit testing check is achieved.

Additionally, visitors entering the isolation room or area used by patients who have suspected or confirmed TB infection should be provided with the N95 respirator mask, and should be instructed by a trained healthcare professional or worker in the TB settings. Patients who have suspected or confirmed TB infection with an active cough and sneeze should also be masked with surgical masks as soon as identified and be moved to an isolation room with good ventilation or room with open windows and door closed.

5.4.2 Recommendations for management

Healthcare professionals and workers working with suspected or confirmed TB patient should be provided with the N95 respirator mask. There is a need for the healthcare facilities managers to introduce the policy compelling healthcare professionals and workers to undergo medical evaluation for potential medical difficulties before they are permitted to use the N95 respirator

mask in the TB healthcare settings. Furthermore, staff should be work-shopped about the importance of medical evaluations and the use of the N95 respirator mask. Healthcare professionals and workers using the N95 respirator mask in the TB healthcare settings should be included in respiratory protection programmes i.e. assigning of responsibility, training and fit testing of the N95 respirator mask. For healthcare professionals and workers to adhere to the correct usage of the N95 respirator mask the following must be in place:

- There should be a designated person with sufficient knowledge who must be given the responsibility to manage or oversee the usage of the N95 respirator mask in the facility
- There must be standard operational procedures for the usage of the N95 respirator mask by healthcare professionals and workers in the TB settings
- Continuous induction and in-service training of healthcare professionals and workers according to the usage of the respirator mask
- OHS trained personnel to perform fit testing of the N95 respirator mask
- Inspection and maintenance of the N95 respirators mask according to manufacturer's instructions
- Periodic evaluation of the respiratory protection programme must take place within the healthcare facilities

The N95 respirator mask is a disposable item, it is a single use item, meaning that the wearer must wear it once when managing the patient and must be discarded thereafter. Re-using of the N95 respirator mask can expose healthcare workers to other infections that are transmitted through droplets or contact. The N95 respirator masks are regarded as patient's used items, therefore it

must treated as a healthcare risk waste and disposed in a healthcare risk waste bin (bin with red plastic liner and lid to close).

5.4.5 Recommendations for practice

- The Gauteng Department of Health should monitor and evaluate the implementations of the written respiratory protection programme policies by all the healthcare facilities in the Tshwane district
- Newly appointed healthcare professionals and healthcare workers should undergo an induction programme for respiratory protection programme on the usage of the N95 respirator mask
- Healthcare professionals and healthcare workers who have undergone the respiratory protection induction course should be provided with a signed acknowledgement of their course
- Gauteng Department of Health should provide a standardised type of the N95 respirator mask that must be used by all healthcare facilities
- Healthcare facilities must develop and implement written worksite specific procedures for proper N95 respirator use, care and maintenance
- Respirator protection programme for use of the N95 respirator mask must be regularly re-evaluated to ensure that it is up to date and effective while considering the following:
    - The type of N95 respirator used or alternatives

        - Healthcare facilities must select a less toxic material and comfortable N95 respirator mask to be used by healthcare professionals and healthcare workers in the healthcare settings
    - Healthcare professionals and healthcare workers participation in the programme
        - Proper fitting of the N95 respirator mask
        - Correctly selected due to the hazardous conditions that the healthcare professionals and healthcare workers are exposed to
        - Worn properly and used when needed
        - Maintained correctly
    - Periodic reviewing the programme
        - Reviewing of the respiratory protection programme to determine whether the correct N95 respirator mask is used and worn properly
        - Whether the respiratory protection programme needs to be changed or updated

5.4.6 Recommendations for further study

There were not enough articles to review for this study; most of articles gathered were repeating themselves, and some articles were not relevant to the study, this made it difficult to compare the specific results with others which could have been found in similar settings. It is recommended that the study on adherence to and the usage of the N95 respirator mask as a TB control measure in the healthcare facilities to be researched in future in other health centres .

5.5 Conclusion

Successful protection of healthcare workers from contracting M-TB in the TB healthcare facilities depends on effective implementation of a respiratory protection programme and the correct usage of the N95 respirator mask. Medical evaluation correct usage of the N95 respirator masks and personnel training are also crucial to the successful implementation of the respiratory protection programmes. Recommendations are made to improve adherence to the usage of the N95 respirator mask by both healthcare professionals and workers during the management of suspected or confirmed TB patients in the TB settings. The findings of this study can be used as a basis for policy recommendations related to TB respiratory protection with the usage of the N95 respirator mask strategy in the TB healthcare settings in the Tshwane district.

REFERENCES

Barclay L, 2010 Surgical mask may be compared to N95 respirator mask in halting Flu transmission. *Medscape medical news*. www.medscape.com/viewartiucle/709810. (Accessed in December 2010)

Biscotto C.R., Pedroso E.R.P., Starling C.E.F. &. Roth V.R., 2005. Evaluation of N95 respirator use as a tuberculosis control measure in a resource-limited setting. *The International Journal of Tuberculosis and Lung Disease,* Volume 9, no 5, pp 545-549.

Boyce J.M., Pittet D., 2002. Guideline for hand hygiene in healthcare settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *American Journal for Infection Control.* Volume 30, pp S1-46.

Brink H.I., 2002. *Fundamental of research methodology for healthcare. South Africa*: Juta & Company Ltd.

Centre of Disease Control, 2006. Respiratory Protection in healthcare settings. www.cdc.gov/tb/pubs/tbfactsheet/rpcs.htm (Accessed on 23/02/2009)

Centre for Disease Control and Prevention, 2010. Respiratory Protection in Healthcare settings. www.cdc.gov/tb/pubs/tbfactsheet/rpcs.htm (Accessed on 10//05/ 2010)

Centre of Disease Control/National Institute for Occupational Safety and Health, 2010. TB respiratory Protection Program In Health Care Administration`s Guide. Publication No. 99-143.

Department of Health, 2007. Core standards of health facilities in South Africa.

Francis J.C., 2007. Tuberculosis infection control. *Practical manual for prevention TB*. www.nationaltbcentre.ucsf.edu (Accessed on 10/04/2009)

Fourie B., 2010. The Burden of Tuberculosis in South Africa. *SAHealthinfo tuberculosis*. http://www.sahealthinfo.org/tb/tbburden.htm (Accessed on 28 August 2010)

Humberger M.J., Roberson O.H., 1948. Expulsion of group haemolytic streptococci in droplets and droplets nuclei by sneezing, coughing, and talking. *American Journal for Infection Control*. Volume 4, pp 690-701.

Lee et al, 2005. Laboratory and Field Evaluation of a New Personal Sampling System for Assessing the Protection provided by the N95 Filtering Face piece Respirators against Particles. *Oxford journals. The Annals of Occupational Hygiene*. Volume 49, pp 245-257.

Marais A., Hoelscher B., Mwaba P., Dheda K., Zumla A. 2010. Eradicating TB in sub-Saharan Africa need effective and commitment in North-South partnership. *South African Medical Journal*. Volume 100, No 3. Published in March 2010.

Minnaar A., 2008. *Infection control made easy*. South Africa, Juta & Company Ltd.

Management of drug-resistant tuberculosis in South Africa: Policy Guideline, June 2007.

Nakajima Y, Mori T, 2001. Stopping the spread of TB. *Japanese hospital case study*. (Accessed on December 10)

National Infection Prevention and Control Policy Manual: South Africa. Published in March 2006.

Paul A. Jensen, Michael F. Lambert, Michael F. Iademarco Renee Ridzon R, 2005. Guideline for preventing the transmission of mycobacterium tuberculosis in the healthcare settings. *CDC/MMWR Journal*. Volume 54, No. RR-17, pp 1-141.

Rengasamy A., Zhuang Z., BerryAnn R., 2004. Respiratory protection against Bioaerosal. *American Journal for infection control.* Volume 32, pp 345-354.

Reproductive Health & HIV Research Unit, 2009. Implementing TB infection control in the healthcare facilities. www.rhru.co.za Published in November 2009.

Research and Education Unit, 2005. Respiratory protection in the workplace. Sacramento, CA95825 (916)574-2528. Published in June 2005.

Shimouchi A, Hirota S, Koda S, Mui K, 2007. Discussion on incidence of tuberculosis patients among nurses. *Osaka City Public Health Office, 1-2-7-1000, Asahimachi, Abeno-ku, Osakashi, Osaka 545-0051*, Japan. a-shimouchi@city.osaka.1g.jp. Published in September 2007

Sidney A.P., 2004. Efficient airborne infection control at low cost, for developing world healthcare facilities. *Industrial and commercial use of energy conference.* (Accessed on 10/06/2009)

South African Government notice no.R.1390. 27 December 2001, OHSA 85 OF 1993. Regulation Hazardous Biological Agent

South African Labour Relation No. 1877. 13 December 1995.NO. 66 OF 1995: *Labour relations act*, 1995

South African National Infection Prevention and Control Policy and Strategy, April 2007.

South African National TB Infection Control Guideline, June 2009.

South African Tuberculosis (TB) and HIV/AIDS Policy Guidelines, 2007.

Stop TB, 2006. Integrating Tuberculosis and Human immune virus. Clinical Management for primary healthcare practitioners. Field test version: December 2006.

Szeinuk J, Beckett S.W, Clark N, Hailoo W.L, 2000.Medical Evaluation for Respiratory Use. *American Journal of Industrial Medicine*. Volume 37, pp 142-157.

Tan L.H, Kamarulzaman A, 2006. Preventing tuberculosis in the healthcare workers of radiology department: a Malaysian perspective. *Biomedical Imaging and Intervention Journal.* Volume 2(1): e3.

Thomas M. Daniel, 2001. Pioneers in Medicine and Their Impact on Tuberculosis. *The Journal of American Medical Association.* Volume 24, pp 286-313.

USAID. Infectious diseases, 2009. http://www.usaid.gov.our_health/id/tuberculosis/countries/Africa/sasfrica_pro pp1-4 (Accessed on 19/05/2009)

Weyer K, 2003. Tuberculosis and HIV in Southern Africa. *African Health Care Journal.* Volume 2: pp 6-9.

World Health Organization. 2005. Global Tuberculosis Control Report. Geneva, Switzerland, WHO/CDC/TB (2005.287).

World Health Organization, 2009. WHO Policy on TB Infection Control in Healthcare Facilities, Congregate Settings and Household, WHO/HTM/TB (2009.419).

ANNEXURES

Annexure A

QUESTIONNAIRE

SECTION A –DEMOGRAPHIC AND WORKPLACE DATA

Infection prevention and control facility based situational analysis.

INSTRUCTIONS

- Answer all questions.
- Fill in the information, using "√" where appropriate.

1. INDICATE YOUR CATEGORY

Nurse ☐ indicate category ☐

Physiotherapist ☐

Doctor ☐

General worker ☐

Clerks ☐

2. INDICATE YOUR AGE CATEGORY.

20-30 years ☐ 31-40 years ☐

41-50 years ☐ >50 years ☐

3. HOW MANY YEARS HAVE YOU BEEN WORKING IN THIS TB FACILITY?

6 months -5 years ☐ 06 -10 years ☐ 11- 15 years ☐

16-20 years ☐ 21-25 years ☐ > 25 years ☐

4. COMPLETE YOUR FACILITY DETAILS BELOW

4.1 Type of the facility

☐ Hospital ☐ Clinic

4.2 Does the facility have dedicated isolation rooms for the management of TB patients?

☐ Yes ☐ no

4.3 Does the facility have infection prevention and control team?

☐ Yes ☐ No ☐ Don't know

SECTION B OHS POLICY AND ADMINISTRATION

5	**Provide details about the respiratory protection policy and programme administration**
5.1	Does your work facility have a written respiratory-protection policy? ☐ Yes ☐ no ☐ Don't know
5.2	Have you undergone training in respiratory protection? ☐ Yes ☐ no
5.3	If yes was the respiratory-protection template (guideline) provided during your training? ☐ Yes ☐ no ☐ Don't know
5.4	If yes do you follow the template (given to you) for respiratory protection? ☐ Yes ☐ no

5.5	Has a program administrator for the respiratory-protection program been designated for your work facility? ☐ Yes ☐ no ☐ Don't know
5.6	If yes respond to 5.6 below. When was the program administrator designated? ☐ Prior to your training session. ☐ Prior to your training session and revised after the training session ☐ After your training session ☐ Don't know
6	**Provide details about medical evaluation**
6.1	Have you been evaluated for potential medical difficulties with respirator use before you were permitted to wear the N95 respirator mask? ☐ Yes ☐ No ☐ Don't know
6.2	If yes when did you undergo medical evaluation for potential medical difficulties with respirator use? ☐ Prior to your training session. ☐ Prior to your training session and revised after the training session ☐ After your training session

7	☐ Don't know
7.1	**Provide details about fit-testing** Do you currently have at least one employee at your work facility who is trained to perform fit-testing?
7.2	☐ Yes ☐ No ☐ Don't know If yes, was this individual trained by the OHS hygienist at this training?
7.3	☐ Yes ☐ No ☐ Don't know Have you been provided with fit-testing before you were permitted to wear a respirator mask?
7.4	☐ Yes ☐ No ☐ Don't know If yes when was fit-testing commenced? ☐ Prior to your training session ☐ Prior to your training session and revised after the training session. ☐ After your training session.
7.5	☐ Don't know In general, how do you check for a good fit of the N95 respiratory mask Describe……

SECTION C: PRACTICES WHEN USING N95 REPIRATOR MASK.

8	**Provide details about the wearing of N95 respirator masks.**
8.1	When should the N 95 respirator mask be worn? You may tick more than one box. ☐ All the time within a shift ☐ when entering an isolation room ☐ when transporting a suspected or confirmed TB patient ☐ when in contact with an unmasked active TB patient.
8.2	During which care activity do you wear the N95 respirator mask? List …… …… …… ……... …… ……
8.3	Is the family of the TB patient required to wear the N95 respirator mask? ☐ Yes ☐ No
8.4	If yes, is there a designated person assisting them (the family) with fit testing? ☐ Yes ☐ No
8.5	Are active TB patients in your facility required to wear N95 respirator mask? ☐ Yes ☐ No Give a reason for your response ……..
9	**Provide details about care, maintenance and disposal**
9.1	Does your work place have a guideline for maintenance and care of your N-95 respirator mask?

9.2	☐ Yes ☐ No If yes give details……. Does your workplace have guidelines on how you should dispose N95 respirator mask? ☐ Yes ☐ No If yes, how do you dispose your mask? ……. …….
9.3	Is the disposal of N95 respirator mask treated as health care risk waste? ☐ Yes ☐ No Give reasons for your response ……..

9.4. How would you rate the overall adherence to the correct usage of N95 respirator Mask, by the following healthcare professional and workers?

Staff category	Adherence	Partially adhere	Non adherence
Doctors			
Nursing staff (all categories)			
General workers			
Physiotherapist			
Clerks			

Thank you for your kind co-operation

Faculty of Health Sciences
Medical School, 7 York Road, Parktown, 2193
Fax: (011) 717-2119
Tel: (011)717-2075/6

Reference: Ms Tania van Leeve
E-mail: tania.vanleeve@.wits.ac.za
04 February 2010
Person No: 328642
PAG

Mr WK Malebati
3928 Unit D EXT 6
Temba
0407
South Africa

Dear Mr Malebati

Master of Science in Nursing: Approval of Title

We have pleasure in advising that your proposal entitled "*Adherence to and usage of the N95 disposable respirator mask as a TB control measure in the health care facilities in the Tshwane District*" has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 William Khabe Malebati

CLEARANCE CERTIFICATE	M090806
PROJECT	Adherence to and useage of the N95 Disposal Respirator Mask as a TB Control Measures in Health Care Facilities in the Tshwane District
INVESTIGATORS	William Khabe Malebati.
DEPARTMENT	Department of Nursing Educatio n
DATE CONSIDERED	09.08.28
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 2009/12/01 CHAIRPERSON .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Prof J Bruce

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and ONE COPY returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

Annexure D

Umnyango wezempilo no Kuthuthukiswa Komphakathi
Lefapha la Maphelo le Tshebeletso le Ntshetsopele ya Sechaba
Department of Health and Social Development
Departement van Gesondheid en Maatskaplike Ontwikkeling

Enquiries : M van Niekerk
Tel : (012)303-9038

12 February 2010

ATTENTION : DR. MADUNA
CHIEF DIRECTOR
CC : MS MOSHEBI
HRM

FROM : MRS. M VAN NIEKERK
HRD

RE : **PERMISSION FOR MR. MALEBETI TO DO HIS MASTERS DEGREE:**

ADHERENCE TO AND STATE OF THE N95 DISPOSABLE RESPIRATOR MASK AS A TB CONTROL MEASURE IN HEALTHCARE FACILITIES IN THE TSHWANE DISTRIDTRES EARCH

Could you please asses the above mentioned request to consider for permission?

Ethical approval has been given.

Mr. Malebati is the infection control officer (AD) for the Region working with Dr. Venter

Ms. Moshebi

Dr. PMH Maduna
18/02/2010

Permission granted / ~~not granted~~

Annexure E

Dear prospective participant.

My name is William Khabe Malebati. I am currently registered as a student at the University of the Witwatersrand in the department of Nursing Education for the degree of Master of Science in Nursing . As part of my studies, I am conducting a research study about the adherence to and usage of the N95 respirator mask as a TB control measure in the healthcare facilities in Tshwane district. I have obtained permission from the Gauteng Department of Health and ethical approval for this study from the University of Witwatersrand Human Research Ethics Committee. As a healthcare professional working in a TB setting I would like to invite you to participate in this study.

I would appreciate it if you would complete a questionnaire, which will take approximately 30 minutes of your time. The questionnaire is divided in three sections.
Section A: Is about your present work situations
Section B: Is about Occupational Health and Safety Act policies on the usage of the N95 respirator mask and respiratory-protection.
Section C: Is about your experiences in using the N95 respirator mask.

All the information provided would be treated in confidence. You are not required to provide your name or any personal information on the questionnaire. If you do not wish to participate or wish to withdraw from the study at any point, you may do so without negative consequences to you or your workplace. If you agree to participate kindly complete the questionnaire and place it in the box provided in your work unit.

There will be no direct benefits to you, should you participate in the study, but the information collected may be helpful to improve the usefulness of the N95 respirator mask.

Should you require any further information regarding the study or about your rights as a study participant please feel free to contact me on the details supplied below.

Yours Sincerely

William Khabe Malebati
E-mail: William.malebati@gauteng.gov.za
Tell 012 303 9047. Cell 082 3328 501