PREVALENCE OF PULMONARY TUBERCULOSIS AMONG CORRECTIONAL SERVICES STAFF IN KWAZULU-NATAL PRISONS

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DEDICATION

I dedicate this work to the fond memory of my late mother, Comfort Adetipe Fawole.

DECLARATION

This Master of Medical Science dissertation is my work and all primary and secondary sources have been appropriately acknowledged. The dissertation has not been submitted to any other institution as part of an academic qualification.

This dissertation is prepared in partial fulfilment of the requirement of the Master of Medical Science (Occupational and Environmental Health) at the School of Family and Public Health Medicine, Nelson R Mandela School of Medicine, University of KwaZulu-Natal, Durban South Africa.

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This is the student's unaided original work except where a specific indication is given to the contrary. The work has not been submitted previously to this or any other University.

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ACRONYMS AND ABBREVIATIONS

CFW	**Correctional Facility Workers**
DCS	**Department of Correctional Services**
HCW	**Health Care Workers**
HIV	**Human Immunodeficiency Virus**
TB	**Tuberculosis**
PTB	**Pulmonary Tuberculosis**
KZN	**KwaZulu-Natal**
SSA	**Sub-Saharan Africa**

ABSTRACT

Background: Prisons and penitentiaries are viewed as environments that act as reservoirs for the transmission of infectious diseases within their confines. This is due to the 'closed' system they operate. The prevalence of these infectious diseases like pulmonary tuberculosis (PTB) among prisoners or inmates has been reported repeatedly in various settings.

Aim: To determine the workplace factors that might lead to an increase in the risk of PTB disease among Correctional Facility Workers (CFWs) in prisons in KwaZulu-Natal (KZN)

Method: An assessment of the prevalence of PTB disease among the CFWs at three correctional services facilities located within the province was conducted. These were randomly selected from a total of 37 prisons in KZN. Questionnaires were administered to determine work activities that may place CFWs at increased risk for acquiring PTB.

Results: There was a response rate of 74.2%, (n=224 participants). Employees had a mean age of 39.2 (SD: 9.2) years and the mean for the number of years worked in the Correctional Facilities was 9.9 years (SD: 6.03). Among the sample, 21.8% had PTB disease during their employment. Nearly a quarter of the CFWs (33 (14.7%)) who had previously been in contact with PTB-positive offenders were diagnosed with PTB while working at the Correctional Facilities. Medical and allied health workers presented with substantially increased (albeit imprecise) risk for acquiring PTB during employment (OR: 19.8 (95% CI: (1.9-202) and OR: 29.4 (95% CI: (2.65-326) respectively)

Conclusions: Findings indicate that CFWs are at risk of developing work-related PTB disease. Healthcare workers recorded a higher prevalence than any other job description. This suggests increased exposure among healthcare workers in these correctional facilities. Appropriate interventions are necessary for the protection of these workers.

CHAPTER 1

Introduction

South Africa is on the World Health Organization's (WHO) list among 30 nations with a significantly high burden of disease as it relates to tuberculosis and it has a very high incidence rate of notified tuberculosis among the countries in the world[1]. Furthermore, it has been reported that tuberculosis remains widespread in South Africa, with an approximate prevalence of over 800 cases per 100,000 population [1]. TB could affect any organ in the body, mostly the lungs. Hence, it is essentially divided into pulmonary and extra-pulmonary TB. Of concern in this study is pulmonary TB (PTB). There is also the phenomenon of TB Infection and TB Disease. The infection entails the acquisition of the infective organism, but the host does not fall ill at that time. This is also called 'latent' TB Infection because the organism may remain hidden in an individual without being infectious or ill. TB disease on the other hand, even though acquired similarly will present with symptoms and is infectious.

As previously stated, there is a preponderance of communicable diseases in the confines of most prisons, and the environment enables the favourable spread of these diseases first among inmates, and then among correctional facility workers (CFWs). These members of staff end up propagating the disease upon further interaction with colleagues, family members, and society at large.[2]

In societies where optimal health care is unattainable like in prisons, they tend to be favourable environments for the growth and propagation of infectious diseases - this is enhanced by the presence of suitable human hosts. Places that are densely populated, for instance, prisons, are important reservoirs for TB transmission. These ultimately pose a threat to those in the general population.[3]

According to the WHO, TB thrives in prisons, and it has become a common saying that prisons concentrate, disseminate; make worse; and export TB.[3] People that are at risk of becoming infected and subsequently transmitting TB within prisons are the prisoners or inmates themselves and CFWs. These would include the warders, cooks, and clinic staff, especially because of their interactions with the prisoners or inmates. These categories of staff could further transmit the disease to their families and the community[3]

PTB disease is an important social problem largely affecting disadvantaged and marginalized communities worldwide. However, according to plans to stop the spread of TB globally,(2011–2015) there is advocacy for early identification and treatment of all TB cases. Furthermore, the need to intensify screening for people in confinement and other populations at risk is encouraged[4]. Due to an increased risk of sickness, high prevalence of mental instability with the attendant risk of self-harm, and elevated rates of infectious diseases especially TB and Human Immunodeficiency Virus (HIV), inmates are regarded as a particularly vulnerable population.[4] The WHO Global TB Control Review also found that the incidence of TB, TB/HIV co-infections and HIV is higher in penitentiaries than in the community. [5]

Background

Numerous factors have been identified as risk factors in the general workplace setting that ultimately determine the incidence and transmission of PTB disease, with the most prominent risk factor being HIV infection. Extremes of age, previous TB infection, sex and smoking are also identified as risk factors. In the prisons, however, the focus on the infrastructure of the prisons puts more emphasis on security rather than environmental controls to reduce the spread of infection. A 2015 study of TB determinants in a Bloemfontein prison concluded that a leading factor that might result in TB outbreaks in prisons is the architectural design and the living conditions of the prisons. Thus, the consequence of poor ventilation enhances a high transmission of PTB disease and outbreaks will affect the inmates, the CFWs as well as the attending healthcare workers and eventually the general population.[5]

Environmental risk factors for infection and possible disease outbreaks will include:

1. Inadequate ventilation.
2. Overcrowding.
3. Close contact among prisoners, CFWs, and visitors.
4. Suboptimal health services, e.g. delay in diagnosis and treatment initiation and hence failure to interrupt transmission.

It is of public health concern that TB is transmitted continuously from the prisoners to people they are in close proximity with. One of the main challenges we face in sub-Saharan Africa (SSA) is the poor information we have regarding TB and other infectious diseases in prisons. Unlike the numerous reports and literature on TB emanating from the USA and Europe, there is little information available regarding PTB disease in Southern African prisons. Largely, this is caused by poor or non-existent surveillance, data collection, and reporting. For the data available in SSA, up to 5% of TB is seen among inmates. There is a suggestion that TB prevalence (lifetime

prevalence) in prisons of certain African countries like Zambia, Malawi, and the Ivory Coast is many times higher than the general public.[3] A report by Global Fund stated that the prevalence of TB within prisons could be 50 times more than the rates observed among the general population.[4]

South Africa accounts for up to 3% of TB disease cases worldwide. Considering the population, the country is frequently seen as one of the highest when it comes to global TB incidence.[6] South Africa is therefore regarded as a high-TB disease burden country. Studies have shown that the TB prevalence in prisons could be as much as 80 times more than the general population, with an 8-fold greater incidence of TB in middle/low-income countries (M/LIC) compared with high-income countries (HIC).[2]

In 1992, a study examined the incidence of TB infection in a New York prison, focusing on prison employees. It was reported to be the first prospective investigation of TB among CFWs. Cohorts considered included CFW, social workers, teachers, and medical personnel. Those categories who had the least contact with prisoners – clerks, management, and maintenance staff - were the referent group. A follow-up study was done a year later. It was discovered that approximately one-third of the employees had new TB infections, as diagnosed by tuberculin skin testing (TST) and repeat testing a year later (two-step testing), even though it was recorded that there was 0.16% evidence of PTB disease among inmates.[7]

The 2021 Global TB report estimates that South Africa is among 8 countries which account for two-thirds of the global total. Despite organized efforts and plans to optimize tuberculosis control programmes with a significantly large quota of international funding over the last 20 years, the disease remains a socioeconomic issue with the disadvantaged communities of the world mostly bearing the brunt[8]

A Tuberculin skin test (TST) survey was conducted among CFWs in Malaysia, looking at Latent TB Infection (LTBI). There was a high prevalence of TST positive among the CFWs – up to 81%.[9] This high prevalence was attributed to the degree of occupational risk the CFWs were exposed to. Incidentally, in the same state in Malaysia, the positive TST prevalence was remarkably higher among CFWs than was seen among HCWs, highlighting the fact that prisons are more potent reservoirs of TB than healthcare facilities.

Literature is limited globally regarding the magnitude of the problem of TB disease within the confines of correctional facilities, among the inmates and staff. Questions remain about the effects of TB disease as an occupational hazard among CFWs in South Africa.

Literature Review

The study involved a literature search in the PubMed, Google Scholar and Web of Science databases using MeSH Terms and phrases as follows: “Correctional services”, “prisons", “tuberculosis”, “inmates”, “occupational Tuberculosis”, and “worker”

This literature review covers PTB disease among workers likely to be at risk for occupational PTB, in particular CFWs. There is overwhelming evidence that describes TB among Healthcare Workers (HCWs). Occupational TB in other congregate settings is not well described in the literature. PTB among offenders has been extensively reported. There, however, have been limited reports among CFWs, particularly in South Africa. Inmates can easily transmit PTB disease not only to co-inmates but to the staff of the correctional facilities as well, especially, with unreported cases of PTB among inmates on transfer from other correctional facilities which have high incidence rates of TB. Overcrowding in the correctional services, malnutrition, and poor ventilation, which are commonplace in correctional facilities can also aid in the transmission mode and rate among all residents of the facility. This review focused on social and occupational factors, and how they contribute to PTB disease among CFW.

Note on terminology: While conducting the literature review, the terms ‘inmates’, and ‘prisoners’ were widely used. Hence, these are featured as part of the search strategy. However, in South Africa, the appropriate terminology is “offenders”. This term is used throughout the dissertation, irrespective of the term used in the study that is being cited.

Tuberculosis among Inmates in Correctional Facilities

It has been widely documented that inmates in penal facilities transmit PTB disease, which provides a problem for TB control.[10] The setting and frequent overcrowding in prisons and jails make transmission easier[11] According to estimations, TB prevalence is between 5 and 50 times greater in penal institutions than the average indices seen in the population.[5] Olivia Cords et al. conducted a thorough review and meta-analysis of the literature spanning 40 years (1980-2020).[12] Based on the WHO classification, the study examined the various geographic regions of the globe. In addition to discovering that TB infection and disease were significantly greater in prisons than in the general population, researchers also discovered that inmates had a higher chance of becoming infected with the disease. Except for North America and the Western Pacific, all seven of the world's regions had prevalence of at least 1000 per 100,000 people. At a 95% confidence interval, the combined incidence of TB infection among prisoners was 15.0 per 100

person-years.[12] Due to the close contact between inmates, infectious diseases can be easily spread within jails. Both TB and HIV/AIDS are major infectious disease morbidity and mortality causes worldwide, and jails have frequently turned into reservoirs for these illnesses.

Globally, the prevalence of tuberculosis (TB) among convicts might be up to 50 times greater than national statistics. TB disease in jail is a significant concern throughout the rest of the world, particularly SSA[13] Aside from immunosuppression brought on by HIV, prisoner-associated risk factors such as inadequate nutrition, stress, drug and alcohol abuse, malnutrition, and related chronic illnesses are frequently linked to the high prevalence of TB in prisons. In addition, unsanitary living conditions in prisons with inadequate ventilation encourage the spread of Mycobacterium tuberculosis among inmates. These host and environmental risk factors make it easier for new M. tuberculosis infections to develop into active diseases, a risk that is at least a factor of ten times higher in prisons than it is in the general population.[13]

In the analysis of articles on HIV and tuberculosis in sub-Saharan African prisons from 2011 to 2015, Telisinghe L et al were able to locate information on only 24 of the 49 nations in the region.[14] In cases when data was available, it was typically of poor quality and infrequently nationally representative. HIV infection prevalence ranged from 2% to 34%, and tuberculosis prevalence ranged from 0 to 16 %; prisoners almost always had a greater incidence of both diseases than the general population in the same nation.

In a Johannesburg prison, the prevalence of undetected tuberculosis with positive cultures was high at 3.5%. However, if those with conventional chest radiographs or sparse sputum smears but negative cultures were included, the prevalence would increase to 7.5%. [15]
Because of different sampling strategies, screening methodologies, and case definitions, direct comparison with other prison surveys from SSA, which reported tuberculosis prevalence ranging from 1 to 6% (3% at a prison in KwaZulu-Natal), was challenging. Our study's tuberculosis prevalence was greater than the projected rates for South Africa's general population (0.8% in 2010) and from mines (about 2.2%).[15]

Although the consensus is that early diagnosis and treatment of PTB disease is germane, this is not extended to prisons it is often neglected and thus put workers at risk.[16] Among offenders in correctional facilities, much work has been done in assessing the prevalence of PTB. [17] High prevalences of active and latent TB cases were reported (2.5% and 61.8% respectively) among

detainees in a prison in Bahia, Brazil. [15] Furthermore, it was observed that the figures found for the prevalence of active TB, if projected for the population (2,500 cases/100,000 population) and compared with the overall prevalence reported in Bahia in the same period (approximately 60/100,000 population), was 42 times greater than what was discovered among the general public in the state of Bahia. This is buttressed by the findings of a systemic review and meta-analysis done in 2021 where prevalence of about 1,000 per 100,000 population was recorded[12] The conclusions of the study corroborate the results observed by several other authors regarding the estimated prevalence of active TB in prison facilities being higher than that found in the community[18.19]

Accurate data on PTB disease in prisons in SSA countries are not readily available since surveillance and data reporting mechanisms are poor or non-existent.[6] In the Mangaung correctional facility study of 2015, the prevalence of PTB disease was 8.8% (8772 per 100 000) among inmates. The authors report that this prevalence was nine times greater (948 per100 000) than the total TB prevalence of the general population (unspecified) as reported in 2009.

TB infection in correctional facilities is a phenomenon that threatens inmates and CFWs (regardless of their job allocation and description) who happen to be at increased risk of being infected with TB due to the environment they work in and the prevailing conditions. During interactions with their families and the community, these members of staff may transmit the disease further. Because of the restrictive nature of the prison infrastructures, the attendant poor ventilation, the sub-optimal health services, and other issues, there is the emergence and spread of Pulmonary TB disease which is drug-resistant and is ultimately being transmitted to the general population.[16]

Tuberculosis among Staff in Correctional Services

From the available literature, it seems LTBI has been the subject of more investigations than active TB among CFWs. **I**n a cross-sectional study on TB among prison workers,(health care and security staff) in Rio Grande do Sul, Brazil, even though no cases of active TB were identified among the CFWs, the prevalence of latent TB was 27.9%.[20] A Malaysia survey found an astonishingly high (81%) prevalence of TST positivity among CFWs, which was linked to longer jail employment. It emphasised the potential occupational risk in such a congested environment

without a regular TB screening program.[9] Grenzel et al demonstrated that there is a substantial risk of TB transmission outside of prisons[21].

Regardless of the job description - administrative, security, or healthcare services, LTBI is a common occurrence among CFW. Although it is challenging to demonstrate that transmission took place within correctional facilities, their study concludes that their data lends support to this viewpoint. In Sub-Saharan Africa, HIV infection also contributes to a higher risk of both inmates and staff in correctional services being infected with TB - up to 70% of adults with TB are co-infected with HIV.[16]Even though there are insufficient studies exploring risk factors within prisons, based on reports from other working environments and general community-based studies, there are several factors found in prison settings, and similar congregate settings that are likely to contribute to these [22]

TB, Occupational hazard for HCWs

As mentioned previously, TB infection and disease have been extensively studied among HCWs. Because of the lack of literature on CFWs, the healthcare workplace, as a congregate setting to which workers are exposed to TB-infected "clients" provides an opportunity to understand the risk among the lesser studied CFWs. The systemic review study conducted in the USA, Brazil, and other places by Baussano et al.[23], provides evidence that the total risk for TB is higher among HCWs when compared with the risk in the community. This finding was replicated among HCWs in India, who had a three-fold greater risk for disease when compared to the general population.[24] Similarly, HCW in KwaZulu-Natal, South Africa had a higher incidence of TB depicting a greater risk of contracting TB infection when compared with the larger community[25]

A systematic review of TB among HCWs in low- and middle–income countries reported a prevalence of 54% on LTBI, in 2006.[26] In this study, certain workplaces (centres with inpatient TB facilities, laboratories, internal medicine, and emergency facilities) and professions (radiologists technicians, patient attendants, nurses, ward attendants, paramedics, and clinical officers) were linked to a higher risk of contracting TB disease. DNA fingerprint surveillance was used to determine that of the 67 HCWs studied over 5 years in the Netherlands, 42% contracted TB disease from work.[27]

Although the elevated risks among HCWs seem self-evident, the occupational risk factors indicate this risk being extended to other congregate workplaces, such as correctional facilities.

The occupational risk factors, such as poor ventilation, small "work" spaces (wards in health facilities), close contact with clients, and non-diagnosis of clients on presentation to the facility, are factors that extend into correctional facilities.

While studying TB among HCWs specifically in KZN, researchers concluded that the TB epidemic in South Africa has been fuelled by the HIV pandemic, historical disregard for health care, fragmented health systems, increased migration, and weak political commitment to TB control.[28]

Problem Statement

Overview

The global estimate of prisons in a country is said to account for the origin of a quarter of all TB cases reported in the entire country.[5] The disease is not restricted to the prisoners alone, but also the CFW who eventually interact directly with their families and the community at large when not at work thereby propagating TB.[2]

Pulmonary tuberculosis disease transmission requires close proximity in which the infected person shares a breathing zone with a susceptible individual. Transmission is also enhanced in buildings with poorly designed ventilation plans which is seen in prisons because the design focuses more on security than infection control.[5] It will, therefore, seem inevitable that the affected prisoners would transmit the illness to correctional services officers and staff with whom they are often in close proximity. This situation makes CFWs quite vulnerable to PTB disease, and it can be classified as an occupational health hazard. This is certainly a public health concern as these CFWs eventually go out into the community, possibly continuously propagating the disease.

Unfortunately, there is a paucity of data when it comes to prisons worldwide in actual terms of the prevalence or incidence among CFWs.[5] While there have been many comprehensive reports of TB in prisons in the USA and Europe, there has been a paucity of literature on TB in African prisons, and accurate data on TB in prisons in SSA countries are not readily available since surveillance and data reporting mechanisms are poor or non-existent.[4] This poses a challenge as the knowledge of the extent of this problem among CFWs is limited in South African prisons.

Prevalence in this thesis is the number of TB cases among correctional facility workers within the facilities under study among currently employed correctional facility workers within the last 10 years, as reported in the questionnaires

Research Questions:

This study, therefore, sought answers to these research questions:

1. What is the prevalence of pulmonary TB disease among correctional services staff in KZN prisons?
2. What are the risk factors that can predispose the staff of correctional services in KZN prisons to developing pulmonary TB disease?
3. What are the occupational factors that enhance TB transmission from prisoners to the staff of correctional services in KZN prisons?

Hypothesis:

CFWs are at greater risk compared with the general population of acquiring pulmonary tuberculosis because of their increased workplace risk.

Objectives and Aims

Overall Objective

To determine the prevalence of pulmonary tuberculosis disease and workplace factors that increase the risk of PTB among correctional facility workers in prisons in KwaZulu-Natal (KZN)

Specific Aims

1. To describe the prevalence of pulmonary tuberculosis (PTB) disease among the different categories of correctional facility workers at prisons in KwaZulu-Natal
2. To describe workplace factors that contribute to PTB disease in prison environments.
3. To describe individual and social risk factors that contribute to PTB disease among the staff.
4. To determine workplace factors associated with PTB in multivariate modelling, adjusting for individual factors and social risk factors

CHAPTER II

MANUSCRIPT

Title

Workplace Risk Factors for Pulmonary Tuberculosis Disease among Correctional Facility Workers in KwaZulu-Natal Prisons in South Africa

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Declaration of interest

The authors have no actual or potentially conflicting interests.

Disclaimer

This article is my original work and has not been submitted to any other journal for consideration

Institution and Ethics approval and informed consent

In compliance with ethical standards, the study was approved by the Biomedical Research Ethics Committee (BREC) of the University of KwaZulu-Natal, South Africa (Reference Number (BE336/18)

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ABSTRACT

Background: The high prevalence of pulmonary tuberculosis (PTB) disease among offenders in correctional facilities has been reported repeatedly in various settings. Against this background, workplace factors are likely to increase the risk for PTB disease among correctional facility workers. This study aims to describe the prevalence and determine work-related risk factors associated with PTB disease among correctional facility workers in KwaZulu-Natal province, South Africa**.**

Methods: A descriptive cross-sectional study was conducted at three major prisons in the province of KwaZulu-Natal, selected based on size and population. PTB outcome was assessed by the information available from the questionnaires and obtained from risk assessment tools. Standardized questionnaire responses from participants included work history, workplace exposures, use of protective equipment, and lifestyle factors. Jobs were categorized as medical staff, allied staff, administrative staff, correctional workers, and ancillary staff. Logistic regression, adjusting for age, educational background, HIV status, smoking, and socioeconomic status, was used to determine the risk for PTB.

Results: There was a response rate of 74.2%, (n=224 participants). Employees had a mean age of 39.2 (SD: 9.2) years and had worked in correctional facilities for a mean of 9.9 years (SD: 6.03). Among the sample, 21.8% had PTB during their employment. 33 of the CFWs (14.7%) who had previously been in contact with PTB-positive offenders were diagnosed with PTB while working at the correctional facilities. Medical staff and allied health workers presented with an increased risk for acquiring PTB disease during employment compared with administrative staff, ancillary staff and correctional workers (OR: 19.8 (95% CI: (1.9-202) and OR: 29.4 (95% CI: (2.65-326) respectively).

Conclusion: Our findings provide evidence that CFWs are at risk for developing work-related PTB. Healthcare workers recorded a higher prevalence than any other job description. This suggests increased chances of disease among healthcare workers in these correctional facilities. Appropriate interventions are necessary for the protection of these workers.

Keywords: Prisons, Correctional Facility Workers, workplace risk, Pulmonary Tuberculosis

Introduction

South Africa has one of the highest burdens of PTB disease, with a prevalence of 852/100 000 population attributed to South Africa.[1] Similarly, incidence of 615/100,000 per population in 2019 and overall TB prevalence of 737/100,000 per population in 2017 were reported[2]. Globally, 1.5 million people succumb to TB every year[3]. The risk of TB in detention centres is especially concerning in South Africa, a country with the highest incidence rates of TB and HIV/AIDS.[4] The incidence of TB in low/medium income countries (LMIC) prisons is 8-fold more than that reported in countries with high income (HIC).[5] The Global Fund estimates up to 10 million people are imprisoned in various penitentiaries globally.

Statistically, South Africa is recorded as having the continent's largest prison population (147,922).[4] The Global Plan to Stop TB programme (2011 to 2015) advocates the need to intensify screening for the most at-risk populations, including people in confinement.[6] Prisoners are regarded as a particularly vulnerable population. The WHO Global TB Control Review also found an elevated prevalence and incidence of TB, HIV, and TB/HIV co-infections among offenders. TB prevalence among inmates and prisoners globally by estimation could be about 50-fold greater than the national average. Thus, CFWs are likely to be at high risk, as they are often in close proximity to the offenders.

Literature is scant about the prevalence and incidence of PTB among CFWs. Some studies have been carried out in Brazil and Malaysia[7,8] In Malaysia, an extraordinarily high (81%) prevalence of latent Tuberculosis infection (LTBI) among full-time personnel of Malaysia's largest prison was reported, and this was correlated with longer employment duration and current tobacco smoking. In the Brazilian study, even though no active TB cases were documented, LTBI prevalence was 27.9%, again attributable to the quantity of time the CFWs had been working in prisons.

Apart from these limited reports on exposure and risk in correctional facilities, workers in other congregate settings, are likely to present with similar risk profiles. These workplaces include homeless shelters, old-age homes, schools, places of worship, and group homes. In some studies on congregate settings in China, the prevalence of active PTB cases was 11.8% [9]. This confirmed that the prevalence of active TB disease was especially high among known risk categories, such as contacts and crowded areas.

Despite South Africa's PTB epidemic, the documentation of the disease is poor in most workplace settings, apart from healthcare and the mining sectors. Reports are virtually non-existent for CFWs. This study aimed to determine the workplace factors that increase the risk of PTB disease among CFWs in prisons in KwaZulu-Natal province, South Africa.

Methods

Study Sites

A descriptive cross-sectional study was conducted at three major prisons (Fort Napier in Pietermaritzburg Medium B, Westville in Durban, and Glencoe in Dundee) in the KwaZulu-Natal province.

Study Population and Sample

The three correctional facilities were chosen in the province based on the size of the facility, the number of offenders present and the number of CFWs employed. These are Fort Napier, in the town of Pietermaritzburg which is a Medium facility (Pietermaritzburg Medium A), Westville in Durban (which is Medium B, referred to as Durban Maximum) and Glencoe, a Medium facility in Dundee. The numbers of CFWs employed in each institution were 585, 615, and 235 respectively.

Previous studies among CFWs,[10,11] in Malawi and the United States reported the prevalence of occupational TB as 4.48% and 0.6% respectively. The closest available population-based prevalence of tuberculosis was recorded in Malawi in 1997 and it reported a prevalence of 81/100,000, which we used as the "non-exposed" population[12]**.** Based on this data, we determined that a sample size of 360 was necessary to show an association between work and PTB disease with a power of 80% and α=0.05.

The recruitment procedure first included obtaining a record list of all workers from each facility, and systematic sampling of every fifth person on the list was conducted. We conducted this process at each of the centres in Pietermaritzburg Medium B, Medium B, Durban Maximum, and Glencoe respectively until the sample size was achieved. These members of staff were invited to participate in the study.

Data Collection

After the completion of the selection process, the invited participants were assembled in a hall in each facility, based on the duty schedules of each CFW. The whole exercise covered 3 weeks. In returning the questionnaires, the participants were advised on the specific procedure to ensure confidentiality and mitigate their own possible concerns. The participants completed the questionnaires at their convenience, placed them in anonymized envelopes that were provided to them, sealed these envelopes personally, and then submitted them to the senior staff. All envelopes were sealed prior to handing the questionnaires to their supervisors. There was no method of identification either on the envelope or in the submission process. These sealed envelopes were then collected by the researcher. The researcher verified that all returned envelopes had no unbroken seals on collection.

At the end of the exercise, 224 (74.2%) copies of the questionnaire were returned by the participants while 78 (25.8%), with either 'no response' or 'partial responses' were collected. The questionnaire was provided in English and isiZulu thus giving the participants opportunities to read and respond in their language of choice. It consisted of questions addressing workplace and individual factors that might contribute to infection transmission. The questions included job title, previous TB diagnosis, use of Respiratory Protective Equipment (RPEs,) ventilation system being used at a workstation, etc.

Risk assessment tools were developed to obtain additional data in addition to the questionnaires. These were based on a tool used to assess PTB exposure risk in health facilities in eThekwini, Kwazulu-Natal[13] and were subsequently administered to only the heads of the various establishments in face-to-face interviews. The goals of these tools were to identify the risk exposure of CFW in their working environment.

Statistical Analysis

Data was captured using Microsoft Excel. This was double captured, compared and corrected to ensure accuracy while analysis and presentation of the data were done using the STATA Version 15.0 (StataCorp. Texas 77845 USA).

The key dependent variable was a diagnosis of PTB disease while working at a correctional services facility, as reported by the participant. Independent risk factor variables included non-occupational risk factors for PTB, including HIV status, history of smoking, and overcrowding at

home. Workplace factors included exposure to offenders with PTB disease or offenders with symptoms compatible with PTB, length of employment at the prison, and job title. The other covariates considered in the study were age, educational background, and socioeconomic status. At the bivariate level, cross-tabulations were used among variables of interest, chi-square analyses were used for categorical variables, and t-tests for continuous variables. The hypothesis was tested using logistic regression in STATA. Those covariates that, in the bivariate analyses were significant at p-value <0.2 were included in the models, along with the exposure variables (job titles, years worked, RPE used when in contact with suspected TB cases, and TB contact during employment)

Ethics

All participants signed informed consent forms and they were informed of the option of refusing to take part with no consequences or opting out of participation at any point without any questions asked. Ethical approval was sought and obtained from the Biomedical Research Ethics Committee of the University of KwaZulu-Natal (Reference number: BE 336/18). Institutional permission was obtained from the Department of Correctional Services

Results

The heads of the various institutions assisted with filling out the risk assessment tool during the face-to-face interviews. These provided additional information regarding policies, the physical infrastructures of the prisons as it relates to ventilation and behavioural differences amongst the CFWs. It highlighted the administrative and engineering controls as well as the respiratory protective equipment that were available. Table 1 presents findings from the risk assessment tool.

769 **Table 1: Risk assessment tool from key informant interviews at each correctional facility**

Facility	**1**	**2**	**3**
Pre-employment TB screening	Yes	Yes	Yes
Periodic TB screening	Yes	Yes	Yes
Exit TB screening	Yes	Yes	Yes
TB IPC policy	Yes	Yes	Yes
Regular IPC meetings	No	Yes	No
Damp dusting done	Yes	No	No
Natural ventilation	Yes	Yes	Yes
Local exhaust velocity	No	No	Yes
HEPA filtrations	No	No	No
Industrial fans	Yes	No	No
Air conditioner	No	No	No
Household fans	No	No	No
N95 available	No	Yes	No
N95 used	No	No	No
Fit testing done	No	No	No
Floor swept	Once daily	More than twice daily	More than twice daily
Floor mopped	Twice daily	Once daily	Once daily
Surface wiped	Once daily	Once daily	Once daily
Bed linen changed	Once a week	Twice weekly	Twice weekly
Bins emptied	Once daily	Once daily	Once daily

770 **HEPA: High-Efficiency Particulate Filter; IPC: Infection Prevention and Control**

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The risk assessment interviews indicated that the management of risks across the institutions appeared to be identical, due to the striking similarities in the infrastructures of these facilities. Screening of staff was said to be done routinely in all 3 centres, in various stages. These are the pre-employment (performed just before the commencement of work in DCS), the periodic (done at specified time intervals while under employment) and the exit screening, which is a prerequisite before leaving the employment of DCS. In addition to the screening, all centres attested to the fact that they have existing TB infection control policies which were being adhered to, even though only one centre has regular training. As part of the evidence of compliance with the policy, floors and surfaces were swept and mopped at least once a day. Bed linens were changed fortnightly in the two centres. Sick bays and consulting rooms were designated places for sputum collection.

All centres relied on natural ventilation through open windows and burglar-proofed doors. Depending on the specific areas considered in the centre, the other methods include local exhaust ventilation and industrial fans. CFWs were said to have been provided with RPE by way of N95 masks in only one centre. There was no fit testing nor was there any formal training on the wearing and the use of these masks before distribution. None of the CFWs were said to be compliant with the wearing of these masks.

The majority of the study participants were females, accounting for 54.9% as seen in Table 2 below. The average age of the sample was 39 years (SD: 9.2). The average years of employment in the correctional facility institutions were 9.9 with no meaningful differences among those with and without PTB. Among the sample, 21.8% were diagnosed with TB while employed at the correctional facility. More females (61.2%) than males had been diagnosed with PTB. The study also revealed that 65.3% of the staff diagnosed with PTB disease had a household occupancy of more than three members. There were no remarkable differences statistically between those with and without TB for key health disorders. Overall, there was a prevalence of HIV (28.6%) and asthma (22.4%).

804 **Table 2: Participant demographics (N=224)**

Demographic variables	TB Diagnosed at DCS n=49 (22%)	No TB during employment n=175 (78%)
Facility		
Glencoe (n=47)	12 (25.5)	35 (74.5)
Pietermaritzburg Medium B (n= 69)	14 (20.3)	55 (79.7)
Medium B, Durban Maximum (n= 108)	23 (21.3)	85 (78.7)
Sex		
Male (n= 101)	19 (18.8)	82 (81.2)
Female (n=123)	30 (24.4)	93 (75.6)
Age (me an) (SD)	38.7 (10.13)	39.3 (9.01)
Number of household occupants		
Less than or equal to 3	17(18.3)	76 (81.7)
More than 3	32 (24.4)	99 (75.6)
Transport mode		
Personal vehicle	43 (23.2)	142 (76.8)
Public transportation	6 (15.4)	33 (85.0)
Level of formal education		
Up to high school	20 (25)	60 (75)
Undergraduate/postgraduate	29 (20.1)	115 (79.9)
HIV positive status	14 (20.3)	55 (79.7)
Asthma	11 (33.3)	22 (66.7)
Persistent coughing	12 (80)	3 (20)

805 Among all those diagnosed with PTB during employment, 67.3% were ancillary (support) staff as
806 shown in Table 3. Of the total health and allied staff participating in the study (n=25), almost half,
807 approximately 44% had acquired PTB disease during employment, compared to approximately
808 19% in all other job categories combined. Contact with offenders that had tested positive for PTB
809 was a risk factor present among 67.3% of those diagnosed with PTB while under the employment
810 of the correctional facility. Only 38.9% had always complied with wearing their N95 face masks
811 during contact sessions with inmates with PTB disease at the facility (Table 3).

Table 3: Risk Factors by PTB diagnosis. Sample size (n=224)

Risk Factors	PTB Diagnosed at DCS n=49 (22%)	No PTB during employment n=175 (78%)
Job Description		
Medical staff	6 (42.9)	8 (57.1)
Allied (Health) Staff	5 (45.5)	6 (55.5)
Administrative Staff	1 (3.7)	26 (96.3)
Correctional Official (Warders)	4 (13.8)	25 (86.2)
Ancillary Staff	33 (23.1)	110 (76.9)
RPE used when in contact	19 (21.8)	68 (78.2)
TB contact during employment	33 (19.4)	137 (80.6)
Years worked at DCS facility (mean (SD)	9.9 (6.3)	9.9 (5.9)

Allied staff –Health care professionals other than doctors; Ancillary staff – Support staff

RPE – Respiratory Protective Equipment used when in contact with suspected TB cases

Logistic regression (as shown in Table 4) revealed that despite broad confidence intervals, the medical (OR=19.8, 95% Cl: 1.9, 202) and allied staff (OR=29.4, 95%CI:2.65, 326) had a substantially elevated risk of acquiring PTB disease while in the employ of the DCS, adjusting for years worked at the facility, PTB contact, use of PPE, smoking and HIV status. Of note was the fact that ancillary staff, although not having direct contact with inmates also showed a statistically significant elevated risk (OR=8.7, 95% CI: 1.01, 70.5). The participants' history of cigarette smoking (OR=3.2, 95% CI: 1.1, 9.3) was an important risk factor. Other workplace risk factors that did not show statistically significant risk were contact with a TB inmate, years of working, and lack of the use of respiratory protection.

831 **Table 4. The crude and adjusted odds ratio for variables in the table (n=224)**

Risk Factors	**TB Diagnosed at DCS**	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
TB contact (n=17)	1.74 (0.87-3.51)	1.9 (0.89-4.1)
Years working at the facility (mean = 9.9)	0.94 (0.5-1.80)	1.6 (0.58-2.30)
Ever smoked (n=55)	3.21 (1.20-8.67)	3.2 (1.1-9.3)*
RPE not used (n=11)	0.97 (0.52-1.91)	1.4 (0.67-2.86)
Job Category		
Administrative (n= 27)	1	1
Medical (n= 14)	19.5 (2.03-187.0)*	19.8 (1.9-202)*
Allied (Health) (n= 11)	21.7 (2.12-221.2)*	29.4 (2.65-326)*
Correctional staff (Wardens) (n= 29)	4.16 (0.43-40)	3.75 (0.37-37.6)
Ancillary staff (n= 143)	7.8 (1.02-59.68)*	8.7 (1.01-70.5)*

HIV Status (n= 3)	1.[15]	1.04
	(0.57-2.30)	(0.50-2.20)

RPE: respiratory protective equipment; OR: odds ratio; CI: confidence interval; * indicates p value <0.05.

The model was adjusted for years worked at the facility, PTB contact, use of PPE, smoking, and HIV status

Discussion

In this study, the first report of PTB disease among CFWs in South Africa, the job title of participants was an important risk factor for acquiring an infection during employment. Medical and allied health staff were at a higher risk of developing TB than administrative staff. Results from this study suggest that other CFWs such as the ancillary staff who were not in close contact with the offenders were also at risk although not as high as those of the medical and allied health staff.

A total of 49 (22%) CFWs reported being diagnosed with PTB disease since the commencement of their employment in the correctional facility where they worked. This prevalence is high when compared to other reports among CFWs in countries like Malawi and the USA.[10,11] Studies in prisons in the United States have found a point prevalence of 17.7% [14.] A Canadian study also reported a point prevalence of 32% among about 100 correctional workers [15]. This prevalence compares with a lower rate among inmates in South African Correctional facilities of 8.8%[16].
In a recent national prevalence study of TB in South Africa, using a multistage, cluster-based, cross-sectional survey design, among 35 191 participants, older than 15 years, a prevalence of 852 per 100,000 was reported. Similarly, an incidence of 615/100,000 population in 2019 and overall TB prevalence of 737/100,000 population in 2017 were reported.[2,17] Against these statistics, we report a strikingly higher prevalence among CFWs .

Pleural TB (which is an extra pulmonary form of TB) is a close differential to PTB. This is often a source of diagnostic dilemma for health care workers. In some instances, patients presenting with clinical features suggestive of PTB or pleural TB are not comprehensively investigated along the line of Pleural TB if PTB is highly suspected[18]. Also, even though pleural TB is expected to resolve spontaneously by default, anti-TB treatment is advisable because around 80% of patients

have associated lung lesions. A significant portion of these individuals can develop active pulmonary TB either immediately or in the future[19]. Hence, both categories of patients are treated with the same regimen of anti-TB drugs

The rate of occurrence of PTB disease is high among CFWs, regardless of where they work in the facilities based on their job descriptions. Occupational factors particularly among those who have been in employment for 11 years or more are significantly associated with TB transmission. Communicable diseases are common in congregate settings such as prisons and correctional facilities, as well as detention centres, homeless shelters, and group homes. Time spent with patients, job designation, work location, and failure to wear personal protective equipment were among the risk factors identified to be responsible for HCWs acquiring TB. Studies in Kenya, Malaysia, and India examined risk factors for TB among HCWs and identified only 2 common risk factors: time spent with patients (particularly TB patients) and work location[20,21,22] They found that HCWs (clinical staff) who spent more time per day with tuberculosis patients had a 2-fold odds of developing tuberculosis when compared with HCWs who spent less than 8 hours with TB patients. This study did not specifically explore the length of time spent in certain common areas as an important risk factor for TB transmission, even though some other studies did report such.[23]They found that there was the possibility that the occupational risk of TB transmission in correctional institutions may be less directly related to job type than to environmental factors such as ventilation or infection control practices.
Thus, the increased risk may be due to closer or more frequent contact with patients. Galgalo and colleagues found an increased risk for tuberculosis among HCWs who spend ≥5 hours per day with patients in Kenya.[20]Additionally, a case-control study from India identified 2-fold odds of tuberculosis among HCWs with frequent contact with patients.[22]

The risk of developing PTB is significantly higher among those with HIV infection.[23]In our sample, there was approximately 30.8% of participants who were HIV positive. Although high, this prevalence reflects that of the South African general population where up to 73% of reported TB cases have HIV as a comorbidity.[24]In our adjusted models, we did not find an increased risk associated with HIV. This may be attributed to the fact that many of these CFWs are well-managed on anti-retroviral therapy. The role of ARVs in mitigating TB risk includes the strengthening of the immune system, prevention of TB progression from infection to disease, reduced TB transmission, and the chances of developing drug-resistant TB are diminished.

Tobacco smoking has a strong link with a high risk of TB.[25] It is an underestimated risk factor for TB and it poses a major hindrance to global TB control efforts.[26]This study also revealed a strong relationship between smoking and PTB disease. Smokers were three times more at risk of being infected with PTB than those who did not smoke. Through its direct damage to the lung structure and disruption of the respiratory immunological and cellular functions, tobacco increases the risk of TB and progression to active PTB disease by about twofold and worsens TB prognosis [27]. A study in Dhaka central jail, Bangladesh, also reported a strong association between smoking and TB with 85.7% of prisoners with TB cases smoking at least five cigarettes per day [28]. In Ivory Coast, 52% of prisoners with TB disease were smokers [29]. Efforts to reduce tobacco consumption should be encouraged, to decrease the risk of TB and related mortality.

According to scientific literature, apart from workplace factors, HIV status and smoking, other lifestyle factors are established risks for the development of PTB[30]. These include the type of housing, primary cooking energy source, number of household occupants, number of rooms per household occupants, and mode of transportation to the workplace. Overcrowding, lack of ventilation, and other negative practices have been identified as risk factors for PTB disease in prisons. These factors dramatically increase the transmission risks of TB. Studies have also shown that conditions prevailing in South African prisons are extremely conducive to the transmission of TB.[31] In this study, the participants however expressed that the facilities had adequate ventilation, in the form of open windows and ceiling fans. However, our bivariate analysis did not show significant relationships between these lifestyle risk factors and was therefore not included in our regression models. For instance, 82.6% commuted to and from work in their personal vehicles, thus limiting the likelihood of their exposure to PTB. Within the home environment, 73% stated that they had an open window policy, thereby allowing for good ventilation; 81% reported they lived in well-spaced housing locations; 86.16% had good electricity; 70.12% stated they used electric stoves, rather than charcoal or paraffin stoves. All of the participants stated they had a good and regular supply of clean water.

There were several limitations in the study. The inability to get a larger random sample was a limitation. This was largely due to the shift structure at the institutions, which meant that many workers were not available at the same time leading to a smaller population size of participants. As acquiring PTB disease was not a reportable condition in the workplace, some workers are likely to have sought health care from private medical services. Hence the total prevalence of TB in these facilities is not known. Studies have shown that the experience of stigma, along with fear of breach of confidentiality and privacy, are frequent themes in studies of health workers'

attitudes to reporting cases of TB. This reflects a lack of trustworthiness in the system with concerns over job security.[32,33]

However, despite these limitations, there are important strengths to the study. Specifically, the use of a risk assessment tool, validated in a previous study involving healthcare workers provided an opportunity to assess TB-related workplace risk.[15]It provided more detailed and focused information on the potential hazards that were present in that work environment. The focus of this instrument was not on the institution generally, but on the section in which the worker was deployed at the time of the diagnosis of PTB disease.

In conclusion, this study is among the few that have documented the risk for occupational TB among CFWs globally, and the first in South Africa, a known high disease-burden country. CFWs bridge the transmission of TB from correctional facilities to the community. Routine pre-employment screening of CFWs on entry into the Department of Correctional Services and regular periodic check-ups thereafter needs to be implemented in the correctional services. Likewise, regular PTB screening programmes should be implemented in correctional settings. Infection control measures, including administrative and personal protection measures, are of utmost importance in preventing transmission in congregate settings such as prisons.[1,11,12] The use of Respiratory Protective Equipment (RPE) by all CFWs should also be enforced. Continued assessment of health risks for CFWs is warranted, given that CFWs may be at risk of exposure to a variety of infectious agents, because their work setting may present challenges to infection control compliance. Medium research into occupational exposure and control for this understudied population of CFWs is strongly recommended. Diagnostic screening in a systematic approach and appropriate management of both the disease and the infection of PTB among prisoners and CFWs will be of great benefit to individuals and the general population.

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CHAPTER III

General Discussion and Synthesis

This study is hinged on the hypothesis that prison staff are at greater risk than the general population of acquiring pulmonary tuberculosis because of their increased workplace risk. Our overall objectives were to determine what factors of the workplace (if any) could increasingly put CFWs more at risk of contracting PTB disease in KZN prisons.

Relatively more studies have been conducted to highlight the high incidence of PTB among offenders as opposed to what obtains in the general population.[6,7] Our study focused on the prevalence of PTB among CFWs. The prevalence we obtained was high at 22%. From the results of the analysis of data generated, workplace factors increasing the risk of PTB among CFWs include TB contact in the working environment, years worked at the facility, and the lack or improper use of RPEs. Others are ventilation problems with the prison infrastructure, and non-adherence to open window policies.

Close contact with TB-infected persons enhances person-to-person transmission of the infective agent, Mycobacterium Tuberculosis. This is further buttressed in the study on prisons and health. Here, it was said that the risk of contracting TB rises when several people who are coughing are situated in a poorly ventilated room. The risk of transmission of PTB disease in settings in which people are in close contact (as in prisons and hospitals) is particularly high. By estimation, about 30% of those in contact with infected people that inhale the mycobacteria via aerosol droplets get infected. However, in situations of overcrowding, like in prisons, the number of contacts becoming infected could be doubled.[31] Even though host-related factors like HIV – co-infection play a major role in the acquisition of TB; it was not a significant finding in this study.

The number of years that CFWs had been working in their various institutions was also significant as a risk factor. The longer the duration of exposure to the infective agent, the more likely a susceptible subject will be infected. This was also highlighted in a United States study, describing how more likely patients would become smear positive and even develop pulmonary cavities due to constant exposure.[32]

There are numerous levels of control usually instituted to eliminate risk factors in the workplace. The last level involves the use of personal protective equipment, in this case, RPEs. From this

study, it was noted that CFWs were generally not so compliant with the use of RPEs. This study did not go further in interrogating whether or not a fit size or fit check was done, even though these are essential in ensuring the efficiency of this level of control. The National Institute for occupational safety and health (NIOSH) has estimated that up to 10 – 20% leakage occurs in masks not properly fitted to the wearer's face.[33]A comparable finding in terms of this low compliance was found amongst healthcare workers in Indonesia.[34] These are important findings as they show the significance of mask fitting.

Regarding the restrictions imposed on features like ventilation in the physical structures of prisons, the transmission of PTB disease is enhanced by buildings with poorly designed ventilation plans – which is seen in correctional facilities and prisons.[35]In this study, however, data revealed that the prison structures in all the centres did have sufficient ventilation systems. For instance, the participants all identified numerous windows which were said to be functional and sufficient, allowing for proper cross ventilation as well as roomy facilities further enhancing ventilation. Because some respondents referred to the availability of air conditioners as possible explanation for good ventilation, there is a need to distinguish between air conditioning and ventilation. Air conditioning focuses on cooling and dehumidifying indoor air. It also filters and removes dust, allergens and other particles. On the other hand, ventilation is primarily concerned with the exchange of circulation of fresh air from the exterior to maintain air quality and remove contaminants.

These were similar to the findings from a study conducted in Brazilian prisons, that improving ventilation has a tremendous effect in cutting down on the risk of transmission daily, thereby reducing the infections in prisons.[36] In that study, lack of cross-ventilation was identified as a major problem. In terms of ventilation, when considering airborne infection control, cross-ventilation is seen to be more effective. This is when there is unhindered ventilation through two adjacent openings. Considering that globally, the primary goal of choosing the architectural designs of prisons and correctional facility centres is security, these ventilation findings will be in keeping with building specifications worldwide – South Africa inclusive.

Other factors which could have contributed to the further spread of PTB disease among workers included the mode of transportation to and from work. Quite a large proportion of the participants did commute to work using their own personal vehicles, thereby reducing the risks of contracting PTB. Those who utilized public transportation for commuting were only 17%. Having live-in

facilities that accommodated family members sufficiently was also examined and it was discovered that a sufficient number of the participants identified with living in the urban settlement, with their own apartments and thus reducing the chances of overcrowding, which could further enhance the spread of TB.

It has been noted that although it is essential to target high-risk populations, inmates are not adequately prioritized when it comes to drawing up policies, and neither are prison programs amalgamated into the national agenda. Hence, WHO has mandated improved focused efforts regarding HIV and TB which include aggressive objectives and goals of being able to identify at-risk groups, getting them tested and subsequently treated. This relates particularly to those that are in prisons.[37] This, among other programs, is an important intervention strategy for both inmates and CFWs.

Bias and Limitations

There are additional biases and limitations in our study that are not covered in the previous chapter. A bias might have occurred among the CFWs, exhibited by a tendency to report more respiratory symptoms, thus overestimating the association between exposure and health outcomes. On the other hand, denial of variables like positive HIV status or smoking habits by the participants was a possibility while considering social stigmatization or job insecurity, thereby creating a bias. This bias is likely to have driven our effect estimates toward the null generally.

As mentioned in the previous chapter, the shift cycles contributed to participation rates and possibly introduced a selection bias. Broadly, the staff was divided into day and night shifts. For the most part, during the administration of questionnaires, attempts were made to administer questionnaires to the CFWs at a point where one shift was ending and the other shift starting. This still proved to be a challenge because there was still another group of staff that were off duty, having performed their overtime. There was some degree of impatience also exhibited by the staff. The night shift staff that was closing were in a hurry to leave, especially because they would still be returning in some hours for the night shift. The daytime staff that was taking over wanted to clock in and resume work as soon as possible. With the gathering of these two categories of staff, it meant that numerous duty posts were left unattended. Hence the possible explanation for many questionnaires left either blank or not completely filled. However, as the shifts are independent of health status, this is not likely to have influenced our outcomes.

Our study was cross-sectional and therefore most relationships had to be inferred. With cross-sectional studies, it is difficult to derive a causal relationship between different variables. It does not allow for a conclusion about causation. This method of study is prone to report bias. Respondents may not have disclosed certain behaviours out of embarrassment, fear or other limiting perceptions. Unfortunately, there is no method for verifying this information. Cross-sectional studies are unable to measure incidence.

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Imprecise estimates (predictions that lack accuracy) usually result from insufficient or limited data, inferences based on assumptions, or attempts to analyse complex systems. In our study, we did not have to deal with any of these possible causes of imprecision.

Even though ventilation or the lack of it plays a very important role in whether or not TB transmission will be continuously propagated, there was no objective method of measuring ventilation.

Based on the Malawi study[38]and the Malawian report,[39] we estimated a required sample size of 360. However, we ended up with a response of 224 and this gave us a power of 0.6 (Appendix G)

CHAPTER IV

Conclusions and Recommendations

Conclusion

In conclusion, the prevalence of TB disease among the CFWs in this survey is high (22%). The study underscores the fact that there is a high likelihood of attributable occupational TB exposure by working in this high-transmission setting.

This high prevalence might be attributable to the following:

1. Risk for job description, with ancillary staff being the highest. This is probably the case because they have the highest number in terms of CFW employees. The HCW (including the allied health staff) and correctional officials expectedly also had high numbers. This is not surprising considering the fact that they had the closest proximity to inmates due to their job descriptions and also because TB is transmitted via aerosols.

2. CFWs work within a confined space, due to the emphasis on security. The priority in prisons and places of confinement is security and all other considerations are secondary. Thus, inmates are kept in confined spaces, and by extension, the CFWs work in these confined spaces. This enhances the transmission of infectious agents, in this case, TB.

3. Prisons are recognized as reservoirs of illnesses and diseases, especially infectious diseases like TB and HIV. The fact that health care in places of confinement is not optimal puts the CFWs at greater risk.

4. Lack of compliance among the CFWs with the use of RPEs. The improper or total lack of compliance in the use of this personal protective equipment was noted in the information supplied by the respondents. For those who complied with the use, whether or not it was fitted and tested before use could not be ascertained. These RPEs are important in the prevention of transmission as they confer some degree of protection from aerosols.

5. The number of years of employment in correctional facility institutions. This has a bearing as a risk factor because the longer the duration of employment, the greater the number of instances that a worker is in close proximity to a TB-infected inmate, and the greater the chances of transmission. For CFWs who have been employed longer than

others in correctional services institutions, the chances of acquiring TB are higher with increased length of exposure time.

6. Tobacco smoking. This has been linked repeatedly to the increased prevalence of TB worldwide. Tobacco smoking in itself is not the direct link, but the fact that it increases the chances of contracting the disease. For CFWs already working in a high-risk area which increases the chances of contracting TB, those who smoke tobacco are at an even greater risk.

Recommendations

Routine screening of CFWs on entry into service and regularly thereafter needs to be implemented in the criminal justice system. In addition to the routine screening at entry into facilities, isolation of presumptive and confirmed cases, infection prevention, and control measures, and appropriate diagnosis and treatment for tuberculosis are interventions that should be prioritized.

TB Infection control measures are of utmost importance in preventing transmission in congregate settings such as prisons.[31] These can be achieved in 4 levels:

- Managerial control measures like avoiding overcrowding of the facilities, operational research, monitoring and evaluation, and drafting infection control measures for TB This also includes advocating for the constitution of Infection Prevention and Control (IPC) committees in the various facilities, and ensuring that they are fully functional, with a designated person to act as a "champion". There is also the need for human resource development and education of all staff regarding the prevention of TB.

- Administrative control measures which include screening and expeditious identification of TB cases. This involves both passive and active case findings, for instance, the use of questionnaires, chest X-ray, tuberculin skin tests, or a combination of these methods. Subsequently, there should be prompt patient isolation as required, and health education in areas of personal hygiene and etiquette.

- Environmental control measures, especially the fact that structures and buildings should be in accordance with ventilation policies. There is a need to ensure adequate ventilation, especially capitalizing on natural ventilation. In some instances, whenever conducive, these centers could employ the use of local exhaust ventilation, HEPA filtration and industrial fans. Another effective form of environmental control targeting these infectious agents is the use of ultraviolet irradiation for eradication.

- Personal protection measures include the provision of respiratory protective equipment like masks and ensuring appropriate fitment and leakage testing. There is a need for other forms of personal protection like gloves, visors. Hand washing facilities should be provided, with either hand towels to dry the hands or air dryers.

Other more specific measures include:

1. Address workplace factors that increase the risk of PTB among correctional facility workers (CFWs), such as TB contact in the working environment, years worked at the facility, and ventilation problems in the prison infrastructure.
2. Regional directors and government policymakers prioritize high-risk populations, such as prison staff and inmates, in policies and programs aimed at identifying and treating those with PTB and HIV.
3. Large-scale surveillance programs should be implemented. This allows for regular screening, identification of latent cases, early diagnosis, prompt treatment initiation, contact tracing, prevention of PTB disease transmission within and outside the prison walls, thereby safeguarding both incarcerated individuals and the broader community.
4. Increase awareness and education about TB prevention among staff members in correctional facilities, with an emphasis on medical and allied staff and ancillary staff. This education should also cover the importance of PPE and its correct use.
5. Implement measures to minimize exposure to TB among staff members, especially medical and allied staff, such as providing them with N95 masks, establishing protocols for handling TB patients, and reducing the number of staff members with direct contact with TB patients.
6. Monitor and evaluate the TB situation in correctional facilities, including the prevalence of TB among staff members, the effectiveness of interventions, and the impact of TB on the health and well-being of staff members.

7. Identify and address other workplace risk factors that may contribute to the development of TB, such as smoking, and take measures to minimize exposure to these risk factors.
8. Conduct further research on other factors that may contribute to the spread of TB among CFWs, such as transportation to and from work and living conditions. Also, further research to better understand the relationship between TB and various demographic and health-related variables, such as gender, age, and HIV status, to develop more effective interventions and strategies to prevent and manage TB in correctional facilities.
9. Consider incorporating prison programs into national agendas and improving focused efforts on HIV and TB to better identify and treat at-risk groups in prisons.
10. Improve infection prevention and control measures: While all three institutions have existing TB infection control policies, only one has regular IPC meetings. It is recommended that regular IPC meetings be implemented in all institutions to ensure compliance with the policies and to identify any gaps that may exist. Furthermore, the frequency of cleaning activities such as damp dusting should be reviewed to ensure that it is adequate for controlling the spread of TB. Additionally, there should be regular training on TB infection control measures for all staff members.
11. Improve Respiratory Protective Equipment (RPE) usage: Only one institution provided N95 masks to CFWs as RPE, but there was no formal training on the use of the masks nor was there any fit testing. It is recommended that formal training on the use of RPE is provided to all staff members and that the use of masks be enforced to prevent the spread of TB. There should be increased compliance with the use of RPEs to protect prison staff from contracting pulmonary tuberculosis (PTB). Management should ensure that RPEs are properly fitted and checked for leaks
12. Improve ventilation: All three institutions relied on natural ventilation, but only one had local exhaust ventilation and industrial fans. It is recommended that all institutions consider installing local exhaust ventilation and industrial fans to improve ventilation and reduce the risk of TB transmission.
13. Improve screening and diagnosis: While pre-employment, periodic and exit TB screening is done routinely in all three institutions, there is still a high prevalence of TB among staff members. It is recommended that the screening process be reviewed to identify any gaps that may exist. Measures also need to be put in place to improve the diagnosis of TB among staff members.
14. Regional directors need to address socio-demographic factors, for example by improving the living conditions and reducing overcrowding in staff members' households, as this

may be a contributing factor to the transmission of TB. There was a higher prevalence of TB among those with a household occupancy of more than three members. It is recommended that interventions be implemented to address socio-demographic factors such as household size that may contribute to the spread of TB.

15. Improve data collection: The study only had a small sample size of 224 participants, and only three institutions were included. It is recommended that a larger sample size and more institutions be included in future studies to provide a more comprehensive understanding of the risk factors associated with TB transmission among CFWs. Additionally, the data collected should be more detailed and comprehensive to identify any other risk factors that may exist.

Our study was able to achieve the major objective we set out to accomplish – determining the prevalence of TB among the CFWs and identifying possible factors that put this category of workers at risk. However, there is a need for large-scale surveillance programs.

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APPENDICES

APPENDIX A

RISK ASSESSMENT TOOL FOR WORKING ENVIRONMENTS OF WORKERS WITH TB

This risk assessment must be conducted in the working environment of each case of TB that is diagnosed in a correctional facility worker at that facility. The risk assessment must be conducted by the officer trained to perform the assessment. The focus is not on the institution generally, but on the section in which the worker was deployed at the time of the diagnosis of TB [Throughout the questionnaire, the section is referred to as the "**affected section"**].

NAME OF PERSON CONDUCTING RISK ASSESSMENT: _____

DATE OF RISK ASSESSMENT: _____

NAME OF SUPERVISOR IN CHARGE: _____

General information on Facility

Facility Name: _____

1. What type of facility is this?	☐ Medium Security ☐ Maximum Security
2. Where is the facility located?	☐ eThekwini ☐ Amajuba ☐ Harry Gwala ☐ ILembe ☐ King Cetshwayo ☐ UGu

	☐ UMgungundlovu ☐ UMkhanyakude ☐ Umzinyathi ☐ Uthukela ☐ Zululand

The following questions refer to the section in which the worker was working at the time of diagnosis (the **"affected section")**

3. What is the number of staff in the affected section?	Total	
	Nurses	
	Doctors	
	Correctional Services Officers	
	Teachers	
	Kitchen Staff and Cooks	
	Cleaners	
	Administration Staff and Clerks	
	Others	
4. What type of section is this?	☐ General Population ☐ Solitary Confinement ☐ Other: _____	
5. What is the total daily patient load at the clinic?		
6. Does the section admit inpatients?	☐ Yes ☐ No [IF NO, GO TO QUESTION 10]	
7. If yes, how many patients are admitted per day?		
8. If yes, what is the average stay	☐ 0-5 days	

in Sickbay in days	☐ 5-10 days ☐ >10 days
9. Is there triaging of patients in this section?	☐ Yes ☐ No ☐ Sometimes
10. Which facilities are available in the section?	☐ Waiting Areas ☐ Consulting Rooms ☐ Visiting Area ☐ Dining Area ☐ Recreation Area ☐ Cell Block 1 ☐ Cell Block 2 ☐ Cell Block 3 ☐ Sick Bay ☐ Ablution facilities ☐ Other_____

1507

1508

1509 **WORK ENVIRONMENT**

1510 **ADMINISTRATIVE CONTROLS**

1511 **Occupational Health**

11. Is TB screening done at employment medicals for all categories of workers?	☐ Yes ☐ No
12. Is annual TB screening for staff being done for all categories of workers?	☐ Yes ☐ No
13. Is TB screening being done with exit medicals for all categories of workers?	☐ Yes ☐ No

14. Is there a TB infection control Policy?	☐ Yes ☐ No
15. Is there an assigned person to monitor policy implementation in this prison?	☐ Yes ☐ No
16. Does regular training on policies-prevention of respiratory infections occur in this prison?	☐ Yes ☐ No
17. How often does it occur?	☐ Once weekly ☐ Once monthly ☐ Once 6 monthly ☐ Once a year

1512

1513

1514 **Hygiene in the "affected section"**

18. How often is the floor swept?	☐ More than twice daily ☐ Twice daily ☐ Once daily
19. How often is the floor mopped?	☐ Every 2 Hours ☐ Twice daily ☐ Once daily
20. How often are the surfaces wiped?	☐ Once daily ☐ Twice weekly ☐ Once a week
21. How often is the bed linen changed?	☐ Daily ☐ Twice weekly ☐ Once a week
22. How often are the bins emptied?	☐ As necessary ☐ Twice a day

	☐ Once a day
23. Is damp dusting done?	☐ Yes ☐ No

Patient flow and sputa management in the "affected section" [If the section does not manage patients, then go to Question 36]

24. What are the average working hours per CFW?	☐ 8 hours ☐ 12 hours ☐ 24 hours
25. Are CFWs screened for TB Symptoms at work?	☐ Yes ☐ No ☐ Sometimes
26. Are coughing CFWs provided with N95 masks?	☐ Yes ☐ No
27. Are there posters educating on cough etiquette	☐ Yes ☐ No
28. Where does sputum collection occur?	☐ Outside the building ☐ Special enclosed area/cough room ☐ In the sick bay ☐ In the consulting room ☐ Wherever it is convenient
29. What is the Turnaround time for sputum	☐ <2 days

results	☐ 2-7 days ☐ 1-2 weeks ☐ >2 weeks
30. Does sputa analysis occur in:	☐ A special analysis room in the prison ☐ In the consulting room ☐ In the cough room ☐ Other: _____
31. How are samples stored?	_____ _____ _____
32. If samples are not analyzed in the section, how are they transported to the analysis department?	_____ _____ _____

1522

1523

1524 **TB contact**

33. How many staff has been diagnosed with TB in the last 12 months in the prison?	☐ None ☐ 1-10 ☐ 11-20 ☐ >20

1525

ENGINEERING CONTROLS

Ventilation

34. What type of ventilation is available in the prison?	☐ Natural ☐ Local exhaust ventilation ☐ HEPA Filtration ☐ Industrial fans ☐ Air conditioning ☐ Household fans ☐ Other: _____
35. Is there a service record for air conditioners?	☐ Yes ☐ No
36. Does the affected section have working fans:	☐ Yes ☐ No
37. Does the affected section have Windows?	☐ Yes ☐ No
38. Does the affected section have cross ventilation	☐ Yes ☐ No
39. Does the affected section have negative pressure ventilation	☐ Yes ☐ No
40. Does the affected section have doors leading outside?	☐ Yes ☐ No

PERSONAL RISK REDUCTION IN THE AFFECTED SECTION

41. Are N95 masks available?	☐ Yes ☐ No ☐ Sometimes
42. Are N95 masks used?	☐ Yes ☐ No ☐ Inconsistent
43. Are users fit-tested?	☐ Yes ☐ No
44. Are there hand-washing facilities in these areas?	☐ Administration ☐ Waiting areas ☐ Visiting areas ☐ Consultation rooms ☐ Dining areas
45. Are there disposable or air hand dryers?	☐ Administration ☐ Waiting areas ☐ Visiting areas ☐ Consultation rooms ☐ Dining areas
46. Are additional personal protection provided in this section	☐ Gloves ☐ Goggles/visors ☐ Other: _____

APPENDIX B

CONSENT TO PARTICIPATE IN A STUDY: PREVALENCE OF PULMONARY TUBERCULOSIS AMONG CORRECTIONAL SERVICES STAFF IN KWAZULUNATAL CENTRES

1. Title of the research project

Prevalence of pulmonary tuberculosis [TB] among correctional services staff in KwaZulu-Natal centers

.

2. Introduction

My name is Adefolarin Fawole, a Master's student at the University of KwaZulu-Natal from the Department of Occupational and Environmental Health. I am conducting research on the prevalence of TB among correctional services staff in KwaZulu-Natal centers. I would like to take a few minutes of your time to determine if you would be interested in being part of the study. KwaZulu-Natal has one of the highest prevalence of TB in South Africa. The employees in this industry are mostly exposed to TB by virtue of their proximity to the offenders. Correctional facilities are regarded globally as reservoirs for TB among other communicable diseases. Studies have been conducted on this health concern in other parts of the world. However, there is very little information on this in our local setting in KwaZulu-Natal and South Africa as a whole.

3. Names of the researchers

Prof. Rajen Naidoo, MB.ChB, PhD	Department of Occupational and Environmental Health, University of KwaZulu-Natal, South Africa Telephone: 031-260 4385; Fax: 031-260 4663
Dr Adefolarin Fawole MBBS	Imbalenhle Community Health Centre, KwaZulu-Natal Department of Health, Pietermaritzburg Telephone: 033-3989100; Fax: 033-3982600

4. Purpose of the research

We wish to ask you to participate in an investigation into the prevalence of TB among correctional services staff in KwaZulu-Natal centers. The purpose of this study is to determine how rampant TB is among the participants.

This will assist in identifying risk factors for the acquisition of TB by correctional services staff due to occupational exposure.

Description of the research project

If you agree to participate in the study, you will be asked to complete a questionnaire at your workplace. A member of our research team will administer a questionnaire to you. You will be asked questions about yourself, your health and any chest symptoms that you may have or had in the past, other medical illnesses, your smoking history, history of your job with correctional services, previous jobs, and your family history. This interview will take about 30 minutes to complete.

5. Risks and discomforts of the research and measures taken to reduce this.

During the interview, you will be asked personal questions. This may cause you to feel uncomfortable. If you are unhappy answering any question, please inform the interviewer. Note that you will not be forced to answer any question.

6. Expected benefits to you and others.

While conducting this study, if it is discovered that you have a disease as a result of the work that you do, and should this be compensable under the law, then we will refer you to an appropriate center for further assessment and intervention. Upon completion of the study, a report highlighting the main study conclusions will be forwarded to you.

7. Costs to you resulting from participation in the study.

The study is offered at no cost to you. If a compensable disease is identified and you need to be referred to a specialist unit, we can recommend to you who to see. However, any additional costs of such medical visits or treatments will not be the responsibility of the study team. The interviews and any other tests that may be necessary will be done during your

normal working hours. We do not anticipate taking up any additional time. However, should unexpected delays occur, and you incur additional costs related to the research, this will be covered by the research team.

9. Confidentiality of information collected

Your name will not appear in any reports on this study. The records of questionnaires and other tests will be kept completely confidential and will be seen only by members of the study team.

10. Voluntary nature of participation

Your participation in this project is entirely voluntary. Even after you give your consent, you may refuse to participate in or withdraw from the study at any time without penalty or loss of benefits.

11. Documentation of the consent

One copy of this document will be kept together with our research records on this study. A second copy will be given to you to keep.

12. Contact person. This study has received ethics approval from the Biomedical Research Ethics Committee, University of KwaZulu-Natal. In addition, permission to conduct the study has also been received from the commander of this center. If you require further explanation regarding the study or if you have any concerns or answers to further questions about the research, your rights, or any problem you may feel is related to the study please contact Dr. A.A. Fawole at the following telephone numbers: Tel: (033) 3989100 Cell: 078 5199950

If you need to obtain additional information about this study, the contact details of the Biomedical Research Ethics Committee, University of KwaZulu- Natal are as follows:

Research Office – Tel: (031) 260 4769; Fax: (031) 260 4609; e-mail: BREC@ukzn.ac.za

13. Consent of the participant

I have read [or been informed] of the information given above. I understand the meaning of this information. Dr/Mr/Ms _____ has offered to answer any questions I may have concerning the study. I hereby consent to participate in the study.

I _____ (First name & Surname) consent to answering a questionnaire.

_____

Participant signature

_____ _____

Witness (Print) Witness signature

DATE: _____

APPENDIX C

IMVUME YOKUZIMBANDAKANYA OCWANINGWENI: UKWANDA KWESIFO SOFUBA EZISEBENZINI ZASEMAJELE EZIKHUNGWENI ZOKUKUHLUNYELELISWA KWEZIMILO KWAZULU-NATAL

1. Isihloko socwaningo

Ukwanda kwesifo sofuba [TB] phakathi kwabasebenzi basemajele ezikhungweni zokuhlunyeleliswa kwezimilo KwaZulu-Natal.

2. Isingeniso

Igama lami ngingu Adefolarin Fawole, umfundi weziqu zeMasters enyuvesi yaKwaZulu-Natal eMnyangweni we-Ocupational and Environmental Health. Ngenza ucwaningo ngokwanda kwe-TB phakathi kwabasebenzi bezikhungo zokuhlunyeleliswa kwezimiulo zasemajele aKwaZulu-Natal. Ngifisa ukucela amaminithi ambalwa esikhathi sakho ukubheka ukuthi ungathanda yini ukuba yingxenye yalolu cwaningo. IKwaZulu-Natal inokwanda okukhulu kwesifo sofuba [TB] eNingizimu Afrika. Abaqashwe kulo mkhakha womsebenzi bavuleleke kakhulu esifeni se-TB ngenxa nje yokusondelana neziboshwa. Amajele emhlabeni uwonke abukeka eyizizinda ze-TB, phakathi kwezinye izifo ezithathelwanayo. Sekwenziwe ucwaningo oluningi ngalesi simo sezempilo esidala ukukhathazeka kwezinye izingxenye zomhlaba. Nokho kunolwazi oluncane kakhulu esimeni sakithi saKwaZulu-Natal naseNingizimu Afrika iyonkana.

3. Amagama abacwaningi

Prof. Rajen Naidoo, MB.CHB, PhD	Department of Occupational and Environmental Health, University of KwaZulu-Natal, South Africa Telephone: 031-260 4385; Fax: 031 – 260 4663
Dr Adefolarin Fawole MBBS	Imbalenhle Community Health Centre, KwaZulu-Natal Department of Health, Pietermaritzburg Telephone: 033-3989100; Fax: 033-3982600

4. Inhloso yocwaningo

Sifisa ukukucela ukuba ubambe iqhaza ekubhekeni ukwanda kwesifo se-TB ezikhungweni zokuhlunyeleliswa kwezimilo emajele aKwZulu-Natal. Inhoso yalolu cwaningo ukuthola ukuthi isidlange kangakanani i-TB kulabo ababambe iqhaza.

Lokhu kuzosiza ekukhombeni amajphuzu obungcuphe bokuthola lesi sifo se-TB kubasebenzi basezikhungweni zokuhlunyeleliswa kwezimilo ngenxa yokuvuleleka ngokomsebenzi.

5. Ukuchazwa kwalo msebenzi wocwaingo

Uma uvuma ukuzimbandakanya kulolu cwaningo uzocelwa ukuba ugcwalise uhla lwemibuzo emsebenzini jwakho. Ilungu lethimba lethu locaningo lizokukhombisa uhla lwemibuzo ngolimi olulodwa oyolukhethu phakathi kwalezi: isiNgisi noma isiZulu. Uma kwenzeka ukuthi lezi zilimi aziyizo izilimi ozisebenzisayo, sicela wazise umhlwayiwolwazi, oyokwazisa umhlwayiwolwazi wocwaningo omkhulu. Uzobuzwa imibuzo emayelana nawe, emayelan nempilo yakho nanoma yiziphi izinkomba zesifuba ongaba nazo nosuwake waba nazo phambilini, okunye ukugula, umlando wakho wokubhema, umlando womsebenzi wakho nezikhungo zokuhlunyeleliswa kwezimilo, imisebenzi edlule nomlando womndei wakho. Le nhlwayalwazi ithatha cishe imizuzu engama-45 ukuyiqeda.

6. **Ingcuphe nokungakhululeki ngocwaningo nezinyathelo zokunciophisa lokhu**

Ngesikhathi senhlwayalwazi, uzobuzwa imibuzo emayelana nawe. Lokhu kungabangela ukuthi uzizwe ungakhululekile. Uma uzizwa ungakuthokozeli ukuphendula noma yimuphi umbuzo, zicela umazise okubuzayo. Qaphela ukuthi awuphoqelekile ukuphendula noma yimuphi umbuzo.

7. **Okulindeleke ukuba kuzuzwe nguwe nabanye**

Ngesikhathi kwenziwa lolu cwaningo, uma kutholwa ukuthi unesifo ngenxa yomsebenzi owenzayo, futhi uma lokho kubonelelwa ngokomthetho, siyobe sesikwedlulisela esikhungweni esifanele uqhubeke nokuhlolwa nokungenelela. Uma seluqediwe ucwaningo, uyothunyelelw umbiko ogqamisa okuzuzwe ocwanigweni.

8. **Izindleka ongena kuzo ngenxa yokuzimbandakanya noncwaningo**

Ucwaningo aluyakuba nazindlekao kuwe. Uma kwenzeka kubonakala ubukhona kwesifo esibonelelwayo, okudinga ukuba wedluliselwe kongoti, siyokuncomela ukuthi ubani ongaya kuyena. Nokho-ke, noma yiziphi izindleko zokwelashwa ezingaphezu kwalokho aziyukuba umthwalo zethimba locwaningo. Inhlwayalwazi nakho koknke okunye ukuhlolwa okunzeka kudingeke kuyokwenziwa ngesikhathi sakho sokusebenza esejwayelekile. Asiboni ukuthi kuyokwenzaka sithathe isikhathi esingaphezulu kwalesi.

Nokho-ke uma kwenzeka kuba nokubambezeleka obekungalindelekile, bese kwenzeka wandelwa yizindleko ezimayelana nocwaningo, lokho kuyosingathwa yithimba locwaniningo.

9. Isifuba ngolwazi oluqoqiwe

Igama lakho angeke livezwe emibikwen yalolu cwaningo. Lapho okuqoshwe khona izinhlamibuzo nokunye ukuhlola kuyogcinwa ngendlela eyisifuba futhi kubonqw kuphela amalungu ethimba locwaningo.

10. Isimo sokuzinikela kwababambiqhaza

Ukubamba kwakho iqhaza kulo msebenzi kuwukuzikhethela ngokuphelele. Nasemuva kokunikeza kwakho ngemvume, ungenqaba ukuzimbandakanya nokuhoxa ocwaningweni nanoma ngasiphi isikhathi ngaphandle kokuhlawuliswa nokwephucwa inzuzo.

11. Ukugcinwa kwemvume

Ikhophi eyodwa yale mvume iyogcicwa ndawonye nokuqoshiwe kwalolu cwaningo. Ikhophi yesibili iyonikwa wena ukuba uyigcine.

12. Ongabathinta

Lolu cwaningo luthole ugunyazo lwenqubonhle lwe-Biomedical Research Ethics Committee, University of KwaZulu-Natal. Ngaphezu kwalokho, imvume yokwenza lolu cwaingo itholwe kumphathi waleli jele. Uma udinjga incazelo engaphezu kwale mayelana nocwaningo noma uma unokukhathazeka okuthil, noma izimpendulo zemibuzo ethile mayelana nocwaingo, amalungelo akho, noma yiphi nje inkinga ozwa sengathi imayelana nalolu cwaningo, sicela uthinte u-Dr A.A. Fawole kulezi zinombolo ezilandelayo: Tel: (033) 3989100, Cell: 078 5199950

Uma udinga ukuthola ulwazi olwengeziwe ngalolu cwaningo, imininingwane yokuxhumana ye-Biomedicala Research Ethics Committee, University of KwaZulu-Natal, yilena elandelayo: ResearchOffice – Tel: (031) 260 4769; e-mail: BREC@ukuzn.ac.za

13. Ukuvuma kombambiqhaza

Sengifude [noma sengazisiwe] ngolwazi olungenhla. Ngiyayiqonda incazelo yalolu lwazi. UDkt./uMnu./uMs_____ uzinikele ukuphendula noma yimiphi imibuzo engingaba nayo mayelana nocwaningo. Ngiyavuma lapha ukuzimbandakanya nocwaningo.

Mina _____ (igama nesibongo) ngivuma ukuphendula uhla lwemibuzo

_____

Isiginesha yomb ambiqhaza

_____

__

Igama likafakazi (uphrinte) Isiginesha kafakazi

USUK

APPENDIX D

QUESTIONNAIRE:

TUBERCULOSIS RISK AMONG CORRECTIONAL FACILITY WORKERS

STUDY ID _____ DATE: ___/___/___

Demographics

1. Name of Facility	
2. Sex	☐ Male ☐ Female
3. Age	
4. Marital status	☐ Single ☐ Married ☐ Divorced ☐ Widowed
5. Highest level of education	☐ Did not complete high school ☐ Matric ☐ National Diploma ☐ Undergraduate degree ☐ Postgraduate degree

Employment

6. What is your current job title?	☐
7. Which section of the facility are you working in? E.g. Admin, Cellblock, Sickbay, etc	☐

8. For how many years and months have you worked in this job?	_____ years _____ months
9. For how many years and months have you worked at this facility?	_____ years _____ months
10. Have you been diagnosed with TB in the last 10 years? (If not, please proceed to No 14)	
11. If yes, were you already employed by the Department of Correctional Services?	
12. In which sections of the facility did you work at the time of diagnosis? 13. If No, where were you working at the time of diagnosis?	
14. Which of the following respiratory protective equipment (RPE) was provided to you on the job at the time of diagnosis	☐ N95 or N99 mask ☐ Face mask
15. Which of the following RPE do you use when in contact with known TB patients?	☐ N95/N99 ☐ Face mask
16. Have you been trained on the correct use of the RPE?	☐ Yes ☐ No
17. Have you ever been employed before your current job?	☐ Yes ☐ No
18. What was the previous job title?	
19. Were you exposed to TB suspects or cases in the previous job title?	☐ Yes ☐ No

1805

1806 **Occupational Exposures**

20. Does the current section you are working in have working fans?	☐ Yes ☐ No
21. Does the current section you are working in have windows?	☐ Yes ☐ No
22. Does the current section you are working in have cross ventilation?	☐ Yes ☐ No
23. Does the current section you are working have doors leading outside?	☐ Yes ☐ No
24. When in contact with TB suspects or TB cases in your department/working environment at the time of diagnosis, what type of ventilation is used? [ONLY INDICATE THAT WHICH IS WORKING]	☐ Natural ventilation via open windows and doors ☐ Air-conditioning for heat control ☐ Air conditioning for heat and air filtration ☐ Fans ☐ Other (please specify)
25. Does the section/working environment at the time of diagnosis or otherwise follow an open-window policy?	☐ Yes ☐ No
26. What type of ventilation is used on cold days?	☐ Air-conditioning units with heating function ☐ Air conditioning units with temperature control and air filtration ☐ Fans ☐ Open windows and doors ☐ None of the above
27. Have you ever worked in one of the following types of working	

environments, if yes, please indicate the number of years	
a) In a foundry?	☐ Yes ☐ No ☐ _____ years
b) In a quarry	☐ Yes ☐ No ☐ _____ years
c) In a pottery?	☐ Yes ☐ No ☐ _____ years
d) In sandblasting?	☐ Yes ☐ No ☐ _____ years
e) In tunneling?	☐ Yes ☐ No ☐ _____ years
f) In drilling?	☐ Yes ☐ No ☐ _____ years
g) In mining?	☐ Yes ☐ No ☐ _____ years
h) In any other dusty jobs?	☐ Yes ☐ No ☐ _____ years

Medical history

Have you ever been doctor diagnosed with the following respiratory conditions?

Diagnosis	Year of diagnosis	Please indicate with (X) if you are currently on treatment for the condition

☐ Asthma		
☐ Bronchitis		
☐ Pneumonia		
☐ Lung cancer		
☐ Chronic obstructive pulmonary disease (COPD)		
☐ Silicosis		
☐ Other occupational lung diseases		

28. Have you been treated for recurrent upper respiratory tract infections in the past year?	☐ Yes ☐ No
29. Have you had a cough (regardless of duration) in recent times?	☐ Yes ☐ No
30. Have you been having a fever in recent times?	☐ Yes ☐ No
31. Have you had unexplained weight loss in recent times?	☐ Yes ☐ No
32. Have you been experiencing drenching night sweats?	☐ Yes ☐ No
33. Have you been hospitalized in the past year?	☐ Yes ☐ No
34. Have you ever been diagnosed with TB before?	☐ Yes ☐ No
35. If yes, please complete the table below for each episode of TB	

Type of TB	Method of diagnosis	Duration of treatment	Duration of sick leave

36. Have you ever received any compensation for TB disease?	☐ Yes ☐ No

37. Do you know your HIV status?	☐ Yes ☐ No
38. If yes, what is your status?	☐ Positive ☐ Negative ☐ Refuse to share
39. If positive, are you on anti-HIV treatment	☐ Yes ☐ No ☐ Not applicable

Family history

40. Do you live with anyone who has had TB in the past year?	☐ Yes ☐ No (proceed to question 44)
41. Regarding this person's treatment, has he/she	☐ Completed TB treatment ☐ Currently taking TB treatment ☐ Did not complete TB treatment
42. Regarding the type of TB, was the diagnosis pulmonary or extra-pulmonary?	☐ Pulmonary TB ☐ Extra-pulmonary
43. Was the TB drug-sensitive or resistant?	☐ Drug sensitive ☐ Drug-resistant ☐ Unknown

Social factors

44. What type of housing do you occupy?

Type of housing	*Number of occupants*	*Number of rooms*	*How many people do you share your bedroom with?*
Formal Housing (Urban)			
Rural Housing			
Hostel			
Informal Housing			

1822

45. How many of the occupants are children under 12 years old?	_____ number
46. Are the houses situated close together (clustered)	☐ Yes ☐ No
47. Does the house have the following: (mark all that apply)	☐ Water ☐ Electricity ☐ Sanitation facilities (toilets) ☐ Electric stove ☐ Gas stove ☐ Paraffin stove ☐ Wood stove
48. Does the house have windows?	☐ Yes ☐ No (proceed to question 50)
49. Are all windows open?	☐ During daylight only ☐ Both day and night ☐ Not opened as air-conditioners or fans are used
50. Have you ever smoked?	☐ Yes ☐ No (proceed to question 58)
51. Are you a	☐ Current smoker ☐ Ex-smoker
52. At what age did you start smoking?	_____ age
53. If you are an ex-smoker, at what age did you stop smoking?	_____ age ☐ Not applicable

54. If you are a current smoker, how many cigarettes are you smoking per day now?	_____ number ☐ Not applicable (ex-smoker)
55. If you are an ex-smoker, how many cigarettes did you smoke per day?	_____ number Not applicable (current-smoker)
56. For how many years did you smoke this amount of cigarettes?	
57. Have you ever smoked other products such as cigars or tobacco pipes?	☐ Yes ☐ No
58. What is your daily mode of transport?	☐ Personal vehicle ☐ Public transport (bus) ☐ Public transport (minibus taxi) ☐ Public transport (train) ☐ Walking ☐ Cycling ☐ Other
59. About how many people are in the same vehicle whilst being transported?	☐ <5 ☐ 5-10 ☐ 10-15 ☐ >15
60. What type of ventilation is used during the commute?	☐ Open windows ☐ Air-conditioner ☐ Fan ☐ None
61. Do you often find that the other passengers are coughing?	☐ Yes ☐ No

APPENDIX E

APPENDIX F

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

28 January 2019

Dr AA Fawole (217080989)
School of Nursing and Public Health
College of Health Sciences
fawoleayo@email.com

Dear Dr Fawole

Protocol: Prevalence of pulmonary tuberculosis among correctional services staff in KwaZuluNatal prisons.
Degree: MMDSc BREC Ref No: BE336/i8

EXPEDITED APPLICATION: APPROVAL LETTER

A sub-committee of the Biomedical Research Ethics Committee has considered and noted your application received 25 May 2018.

The study was provisionally approved pending appropriate responses to queries raised. Your response received on 18 December 2018 to BREC correspondence dated 18 July 2018 has been noted by a subcommittee of the Biomedical Research Ethics Committee. The conditions have been met and the study is given full ethics approval and may begin as from 28 January 2019. Please ensure that site permissions are obtained and forwarded to BREC for approval before commencing research at a site.

This approval is valid for one year from 28 January 2019. To ensure uninterrupted approval of this study beyond the approval expiry date, an application for recertification must be submitted to BREC on the appropriate BREC form 2-3 months before the expiry date.

Any amendments to this study, unless urgently required to ensure safety of participants, must be approved by BREC prior to implementation.

Your acceptance of this approval denotes your compliance with South African National Research Ethics Guidelines (2015), South African National Good Clinical Practice Guidelines (2006) (if applicable) and with UKZN BREC ethics requirements as contained in the UKZN BREC Terms of Reference and Standard Operating Procedures, all available at http://research.ukzn.ac.za/ResearchEthics/ Biomedical-Research-Ethics.aspx.

BREC is registered with the South African National Health Research Ethics Council (REC-290408-009). BREC has US Office for Human Research Protections (OHRP) Federal-wide Assurance (FWA 678).

The sub-committee's decision will be noted by a full Committee at its next meeting taking place on 12 March 2019.

We wish you well with this study. We would appreciate receiving copies of all publications arising out of this study.

Yours sincerely

Professor V Rambiritch
Chair: Biomedical Research Ethics Committee

cc postgraduate administrator:ramlalm@ukzn.ac.zaSupervisor:naidoon@ukzn.ac.za

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Biomedical Research Ethics Committee
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Email: brec@ukzn.ac.za Website:
http://research.ukzn.ac.za/Research-Et1ics/Biomedical-Research-E hics.aspc

APPENDIX G

Sample size calculation using the Malawi study[38] and Malawi TB report[39]

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. power twoproportions 0.00081 0.0448, test(chi2) n(224)

Estimated power for a two-sample proportions test
Pearson's chi-squared test
Ho: p2 = p1  versus  Ha: p2 != p1

Study parameters:

        alpha =    0.0500
            N =       224
  N per group =       112
        delta =    0.0440  (difference)
           p1 =    0.0008
           p2 =    0.0448

Estimated power:

        power =    0.5979

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