Prevalence and risk factors of tuberculosis amongst inmates at the Boksburg Correctional service

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Declaration

I hereby declare that the study: Prevalence and factors associated with Tuberculosis amongst inmates at the Boksburg Correctional Services (mini – dissertation ) hereby submitted to Sefako Makgatho Health Science University for the degree of Masters in Public Health , in the field of health science , has not previously been submitted by me or any other university and is my own work and that the sources used or quotations cited have been indicated and duly acknowledged by means of complete references.

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Ntombi Mildred Tsotetsi Date:

Student number: 201530577
Acknowledgment

This study is dedicated to my God, who strengthened me and gave me courage through his word.

Firstly, I would like to cite a Sotho proverb that says, “Thuto ha e tsofallwe”, which means you are never too old to learn new things. I would also like to extend my deepest appreciation and gratitude goes to the following people;

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Abbreviations

AIDS                         Acquired Immune Deficiency Syndrome
ART                          Anti-retroviral therapy
BCS                          Boksburg Correctional Service
CI                           Confidence Interval
DCS                          Department of Correctional services
DOH                          Department of Health
ETR                          Electronic Tuberculosis Register
HIV                          Human Immune Virus
ICN                          International council of nurses
ILL                          International Library
MDR                          Multi-Drug Resistance
MDR –TB                     Multi- drug resistant tuberculosis
MTB                          Micro bacterium tuberculosis
NTP                          National TB programme
PTB                          Pulmonary Tuberculosis
S.A                          South Africa
SAMJ                         South African Medical Journal
SMU                          Sefako Makgatho University
SMUREC                       Sefako Makgatho University research ethics committee
TB                           Tuberculosis
WHO                          World Health Organisation
Summary

Tuberculosis (TB) is one of the global health problems that are causing poor health in millions of people each year. The study aimed at investigating TB burden and factors associated with it amongst inmates at Boksburg Correctional Service.

This was a cross-sectional study based on a review of records using a set of data collection forms specifically designed for the study. The TB registers were used as the starting point to identify patients treated for TB and the statistics of the total number of inmates for each year were provided by prisons authorities.

It was found that this prison facility housed only male inmates. Those with TB had a mean age was 43 ± 9 years old. Their age ranged from 20 to 60 years old; the majority of those affected were 30 years to 49 years old. Though the majority of them did not have a previous history of TB, they had been in contact with TB-infected cellmates; moreover, more than half of them were co-infected with HIV. With regard to the TB burden at this study site, the overall prevalence and incidence of TB during the 3-year period were 4.6% and 961 per 100.000 or 1% of inmates respectively. The prevalence increased from 3.5% in 2014 to 7.1% in 2016; while the incidence ranged from 647 in 2014 to 1440 in 2015 before decreasing to 797 per 100.000 in 2016. The case fatality rate decreased during the same period from 0.09% in 2014 to 0.05% in 2016.

Almost all patients suffered from pulmonary tuberculosis; they have been diagnosed, mainly, using GeneXpert, and had been provided with the essential interventions including HCT, ART, and cotrimoxazole and isoniazid prophylaxis. They had been treated with regimen 1 as per the national TB treatment guidelines. The outcomes of treatment were very encouraging, as more than half of inmates on treatment were confirmed cured, while 41% had completed their treatment.

With regard to factors that appear to play a role in the transmission of TB among inmates at this study site, it is noted that besides contact with an infected inmate, there was overcrowding, which ranged from 135 % to 202%; and comorbidities, mainly HIV.

In conclusion, the prevalence and incidence of TB among inmates at the study site were relatively high and showing an increasing trend. Despite the presence of the ever-present overcrowding, it is laudable that the treatment success was very good. It is recommended that
the screening of inmates at incarceration should continue to be carried out so that people with no TB should be housed in appropriate cells; and that a surveillance program to identify inmates TB should be instituted as that inmates found with active TB should be separated from the others until they become on-infectious after at least 2 months of treatment.
Chapter 1: Introduction

1.1 Background and overview on tuberculosis

Tuberculosis (TB) is one of the global health problems that are causing poor health in millions of people each year. It was ranked as the second leading cause of death in the whole world after HIV according to the World Health Organisation in 2015. In 2014, there were an estimated 9.6 million new cases of TB, of which 5.4 million were men, 3.2 million cases in women, and 1 million in children. Overall, deaths due to TB amount to approximately 1.5 million, of which 1.1 million occurred among HIV-negative persons and 400 thousands in HIV-positive people (WHO, 2016).

Parallel to these bleak statistics, is the occurrence of active tuberculosis in prisons worldwide. TB is a growing public health challenge in prisons. Over the last century, global control efforts have reduced the incidence and prevalence of TB worldwide, yet TB in correctional settings such as jails, prisons, and detention centres; it is still a growing concern, which is usually reported to be much higher than the average levels reported for the corresponding general populations. Worldwide, correctional facilities house large number of inmates who are at high risk of developing TB. For instance, on any day, worldwide about 10 million people remain incarcerated, in prisons, police stations, jails and detention centres. As a result, these settings pose a problem for those imprisoned and for the wider society (Barron et al, 2014). The incidence of TB, in prisons, is 5 to 70 times greater than in communities they originate from (USAID, 2013).

South Africa has the fourth highest global incarceration rate, with an average of 155 000 prisoners in 237 operational prisons (Department of Correctional Services, 2016). Its prisons have high risks of spreading TB due to overcrowding, lack of ventilation and poor prevention practices, which dramatically increases transmission risk of TB (Mahlatsi, 2015).

Several factors contribute to the situation of TB in prisons. These include limited awareness campaigns done in the prisons, little health promotion, insufficient staffing; as well as lack of early diagnosis and prevention strategies like extractor fans or mono-directional airflow, open windows. These shortcomings facilitate the transmission of airborne droplets produced by coughing or sneezing which remain airborne for extended periods of time (Reider, 2007).
The exacerbation in TB burden in South Africa is driven by the high prevalence of HIV infection amongst inmates, as TB is the most common opportunistic infection amongst people living with HIV in Africa. TB prevalence and poor control policies within prisons also create potential breeding grounds for multidrug-resistant TB (MDR–TB) which might also impact on the wider community (Johnstone–Robertson 2011). As a result, prisons’ settings pose a problem for those imprisoned and for the wider society.

Moreover, overcrowding with prolonged exposure through long prison sentences, cigarette smoking, unsafe and illegal drug use practices, forced unprotected sex, all facilitate close contacts; hence, the transmission of TB (Telisengle et al, 2014). Furthermore, medical staff shortage, coupled to low funding of prisons services means that there is no or little screening for TB, and training of staff on updated TB guidelines, this situation render prisons breeding grounds for TB (Robensons, 2011).

1.2 Situation of tuberculosis in South African prisons

South Africa was one of the countries with the highest known cases of tuberculosis, with WHO statistics giving an estimated incidence of 450,000 cases of active TB in 2013. Roughly, 1% of the population, of 50 million contract TB each year (WHO, 2015). It is ranked third, based on worldwide incidence, after India and China. The number of TB cases has increased by 40% over the past few years. Data from DCS in 2011 indicated an incidence rate of 4500/100,000 inmates as compared to 993/100,000 people in the general population (WHO, 2012). In general, it is reported that the prevalence of TB in Sub Saharan Africa prisons is estimated to be 6 – 30 times higher than in general community (DOH, 2013).

TB in South Africa has been described as “ranging out of control” due to the high contraction rate seen in the correctional services. However, on December 2012 the South African Constitutional Court ruled that the state had been negligent in its approach in managing TB in prison since a prisoner, Dudley Lee, had sued the Department of Correctional Services (DCS) for his infection with tuberculosis whilst he was incarcerated in Pollsmoor prison (Robin-Wood 2012).

The constitutional court recognised that the DCS was aware that there was a risk of infection and contagion in crowded living environments with little to no ventilation and sharing of cigarettes, which increase the chances of infection. This resulted in the DCS drafting policy
guidelines for the management of TB in correctional service centres, which is a challenge even to date (DCS, 2013).

1.3 Context of the study and problem statement

South Africa has one of the best constitutions in the world, which advocates the right to health and this is being implemented through primary health care approach. The Department of Correctional Services is a primary health setting where promotion, prevention, and curative function of health programs take place; however, the prisons settings have been designed primarily to prevent crimes and escapes rather than with public health considerations; which is why infrastructural measures for TB prevention are difficult to implement in prisons (Malangu and Mngomezulu, 2014).

As stated earlier, South Africa is amongst the countries with the highest burden of TB worldwide (WHO 2013). Meanwhile, TB in South African prisons remained a major threat to inmates, due to the living conditions such as overcrowding, poor ventilation, poor nutrition, poor hygiene, and poor access to health services (Telisengle et al, 2014; Robin-Wood 2012).

Even though the prevalence of active TB in prison is usually reportedly much higher than in the average population, there are few publications about the actual prevalence of TB in prisons. In fact, for Ekurhuleni district, no such data was found in the literature review for Boksburg Correctional Services (BCS) and Moddebee Correctional Services (MCS). This study sought to fill this gap. Boksburg Correctional Services in Gauteng, South Africa, is situated in the Ekurhuleni Metropolitan area, at the southern part of the district (see Map).
In line with the need to fill the identified gaps, this study purports to answer the study questions described below.

### 1.4 Research questions

In order to address the goal of the study, the following questions were considered:

1. What is the profile of people who have TB in the Boksburg correctional services (BCS)?
2. What is the prevalence and incidence of TB amongst inmates in Boksburg correctional services?
3. What are the factors associated with TB amongst inmates in Boksburg correctional services?
4. What is the trend in TB prevalence at BCS during the study period?
1.5 Purpose and objectives of the study

1.5.1. Aim of the study

The study aimed at investigating TB burden and factors associated with it amongst inmates at Boksburg Correctional Service.

1.5.2 Objectives of the study

➢ To determine the profile of patients suffering from TB amongst inmates at BCS
➢ To determine the prevalence and incidence of TB amongst inmates in BCS
➢ To identify factors associated with TB in inmates at BCS
➢ To determine the trends in TB prevalence and incidence from 2014 to 2015 at BCS

1.6 Rationale for scope of study

Decision-makers and policy-makers need credible information to do their work. The same apply to institutional managers who have to plan for service rendering and budget for required resources. The lack of specific disease burden data for BCS makes it difficult to plan appropriately. This study will, when completed, provide data that can be used by policy-makers and institutional managers to make informed decisions about the situation of TB at BCS.

1.7 Significance of the study

The burden of tuberculosis (TB) in prisons is high and of great concern. Together with other infectious and communicable diseases, TB poses a challenge that must be addressed. In conducting this study, it is hoped that the findings will provide critical data that will assist both the National Tuberculosis Control Program and the DCS to have factual data on the situation in order for them to design effective management interventions that will curb or prevent the spread of TB at this facility and other prisons. The data from this study could serve as a baseline from which progress made can be measured against.
1.8 Composition of the mini-dissertation

The above concludes Chapter 1 that describes the context of the study as well as its research questions and objectives. In the subsequent pages, Chapters 2 and 3 will respectively present a review of literature and the research methods used. Chapter 4 will present the findings while the final Chapter 5 will discuss the findings, the limitations of the study, its main conclusions and its recommendations.
Chapter 2: Literature Review

2.1 Introduction

This chapter outlines the findings about prevalence and risk factors of tuberculosis amongst inmates in prisons, beginning from the global and continental levels, looking into the similar studies within the sub-Saharan Africa; then moving down to local studies that dealt with this topic. As explained by Taylor (2008), a literature review serves to convey to the readers, what is known about the topic in relation to the envisaged study. In the following pages, the search strategy of relevant publications is described; this is followed by a presentation of what is known on the topic; a concluding remark ends this chapter.

2.2 Data search strategy

Data searching was done to collate articles and any other relevant sources about the topic of the study. The sources searched included libraries, bibliographic databases, published journals, and internet engine searches (Margaret Rooney, 2013).

Before the researcher engaged in the searches, a set of keywords was decided upon, so as to assemble them to be used in the search, and a mind map was drawn to be able to guide an initial direction of where and how to look for clear understanding of the topic. The following keywords and phrases were used: prevalence, incidence, tuberculosis, risk factors, problems, challenges, TB management, prisons, and correctional services.

The search terms were used individually and then combined using Boolean operators AND and OR the use of Boolean operators which allows a wider exploration search of literature (Rasmuson, 2014).

The resources that were used and available for the literature search were books, journals, including both hardcopies and electronic databases. However, the initial library hardcopy search did not reveal many current sources, and therefore, primary focus was on searching various electronic databases such as:

- Google scholar
- PubMed
A manual of literature on the local journals and around the health authority library was also done. The Sefako Makgatho Health Science University (SMU)’s library resources including databases were also used.

The latter enabled the researcher to obtain documentary and electronic information and data that are only available from other academic institutions and organisations with which SMU is affiliated or contracted with.

Archives, databases, and websites of other local and international sources of information, such as e.g. Human Science research council (HSRC), International Council of Nursing (ICN), World Health Organisation (WHO) etc. were reviewed in the quest to obtain a multi-perspective approach to the research topic.

2.2.1 Criteria for inclusion and exclusion

Inclusion

- Studies that reported prevalence of TB in prisons
- Studies that looked at factors associated with TB
- Studies that are published in English
- Only literature from scholarly databases were considered.

Exclusion

- Studies published before 1980
- Studies whose academic credibility could not be authenticated
- Studies written in language other than English.
2.3 Burden and risk factors for tuberculosis in prisons

Internationally, South Africa is one of the top 20 most affected countries by tuberculosis (WHO, 2007). With regard to the prevalence of TB in prisons, several studies in other countries have reported high rates of TB among inmates. A systemic review that was performed in US to assess risk of incidence of TB in prisons revealed the estimated annual incidence rate ratio to be 26.49 (Baussano et al 2010).

Even in developed countries, the situation of TB is as critical. Studies in Barcelona (Spain), California and New York (USA), have reported a prevalence of respectively 56%, 30% and 20% (CATIE 2015). A population based study on prevalence and risk factors on TB in Georgia showed the results of 60.8% were newly diagnosed and 39% had been those who were previously treated (Blumberg et al, 2009).

A case control study in Russian prison Moscow also showed TB prevalence confirmed with associated risk factors like overcrowding, sharing a room with infected person and calculations using the univariate odds ratios yield population attributable risk of 0.8% and 2% for having been in prison or pre-trial detention centre (Coker, 2005).

High rates of TB co infection are believed to exist in Russian prisons; prisoners with TB were studied also to identify the following:

- Clinical and social factors, which may compromise the effectiveness of TB treatment, or a patient’s adherence, resulting treatment failure.
- Prevalence of HIV, and risk factors for HIV and other blood borne virus infections.

As a result, HIV and Hepatitis B/C co infection occurred in 12.2%, 48.6 % of prisoners used drugs of which 88.3% were intravenous users and 40.2 % prisoners shared needles, two thirds of them had received previous TB therapy and were more likely to have had previous and repeated therapy. Prisoners are major drivers of the Tuberculosis and HIV epidemic. Novel strategies are needed to reduce the spread of infections particularly in intravenous drug users.

In the Middle East and Asia, the situation is also precarious. A survey conducted to assess the prevalence of TB infection using PPD skin test infection among 3931 inmates in all 21 jails in Lebanon. Forty-five per cent of participants had positive PPD skin test though the likely hood of testing positive was higher amongst men versus women (Adib, 2009).
In Pakistan, the TB prevalence in correctional services according to study done in North Frontier Province Pakistan was at 48%; poor infection control was amongst the risk factors identified to be accelerating latent infection (Hussain et al, 2003).

In South America, similar trends are found. For instance, in western sector of the city Sao Paulo, Brazil, the rate of TB among prisoners was reported to be 2065 cases per 100000 prisoners; a figure which is 70 times higher than the average found in the Brazilian population. Furthermore, of the 21 MTB strains identified, 85.7% were sensitive and 9.5% were resistant to INH and RIF (Abrahao et al, 2006).

On the African continent, Dolan and colleagues (2016) have reported that Prevalence of tuberculosis was 5.3% in East and Southern Africa; and 2.9% in West and Central Africa. As shown below, some countries had even higher prevalence rates.

For instance, studies in Ethiopia reported that in the Eastern region that involved 2008 371 prisoners, showed that 8.9%, or 33, out of 371 PTB suspects identified by active screening, were confirmed as smear positive PTB. The point prevalence of TB was 1913 per 100000 (95% CI 14010- 2580), about seven times higher than that of the general population. In the South West Ethiopia was conducted for people living with aids who developed active Pulmonary Tuberculosis, an interviewer administrated structured questionnaire was used to collect information on potential risk factors. A history of contact with a tuberculosis patient (OR=2.0; 95% CI: 1.2.3. and sharing a cell (OR=3.7; 95% CI 1.5.7) five were independently associated with the development of active TB in people living with HIV/AIDS. As a result all HIV patients must be screened for TB and as well all TB patients must be screened for HIV, however in the presence of the risk factors mentioned above, intensified screening is recommended.

Surprisingly, in Addis Ababa, a prevalence of 4.9% was reported in Ethiopian prisons (Abebe et al, 2011). While a study from the Central Prison of Douala in Cameroon reported that of the 2474 out of 2830 inmates who underwent screening:

- 1.1%, or 27, of the inmates were under treatment for smear positive PTB on commencement of survey
- 2.4% (60), were diagnosed with both smear /culture positive PTB during case findings, resulting in a point prevalence of PTB of 3.5 %.
- HIV sero – prevalence in inmates without clinical signs of PTB was 10.4% while it was 25% in PTB patients. In multiple stepwise regression analysis, a low BMI, a
prison stay of < 12 Months and a history of previous incarceration were positively associated with PTB.

In Cameroon where 10 major urban, semi urban and rural prisons which are situated in different regions of that country, and hold about 45% of the total prison population of 23 500. These prisons are characterized by severe overcrowding, for each prison data on prisoners diagnosed with PTB during the study period October 2011 – September 2012, as well as their date of admission to prison, were extracted from the standardised TB register. The findings were that overall, 178 TB cases were notified or 1 700 cases per 100 000, the incidence rate ratio was 9.4 (95% CI 8.1- 10.9) (Noeske; Ndi; Amougou; Mbondi; SAMJ 2014).

In South Africa, a recent study reported a point prevalence of laboratory-confirmed undiagnosed TB among inmates to be 3.5% (Telisinghe et al, 2014). According to Sonke Gender Justice, an organization that advocates for access to medical services in prisons, among other campaigns, tuberculosis is seven times more common in the country’s prisons than in the general population (Goyer, Saloojee and Richter, 2007).

Among the factors cited as associated with the prevalence, include the high staff turnover of healthcare professions in correctional services and limited ability to provide prisoners screening services as explained above (Vanleeuw, 2009).

With regard to overcrowding, the situation is dire: It is reported that by the end of March 2016, South Africa’s prisons only had 119,134 bed spaces available for its 161,984 inmates; in some facilities like Johannesburg Correctional Centre, bed occupancy was estimated to be 233% full, which translates into a shortage of 1,736 beds (Africa Check, 2017).

Other factors according to a review conducted in 2006, include proximity to an infected person, needle sharing and high-risk sexual behaviour (Niveau, 2006).

2.3 Concluding remarks

The above review indicates that some studies have been conducted on the topic of the prevalence of TB in prisons but none has been conducted specifically at the study site. Furthermore, a record specifically based on review of records of actual inmates was not found on the situation at the study sites. It was important to undertake this study in order to provide data specifically for Boksburg prisons.
Chapter 3: Research Methods

3.1 Introduction
This chapter presents the research approach including the design, instruments/tools, data collection, and data analysis including processes involved in carrying out the study.

3.2 Study site
The study was conducted at Boksburg correctional services, in the Ekurhuleni district, east of Gauteng Province. It is a facility comprising juvenile and adult sections as detailed below.

3.3 Study design
This was a cross-sectional study based on a review of records using a data collection forms specifically designed for the study. The TB registers were used as the starting point to identify patients treated for TB. Then the other registers and documents providing details on inmates were also perused together with the statistics provided by the institutional managers on the numbers of inmates for each month during the study period. It was recorded on a form to tally the number of inmates at the beginning and end of each month, those who were known TB patients, those who were newly diagnosed and any other relevant information about them such as having been discharged or died (Appendix 1).

Based on the above information, it was possible to calculate both the prevalence and incidence per year. Furthermore, data on the number of beds officially available at the facilities and the number of inmates were used to calculate the bed occupancy, thereby estimate the overcrowding.

3.4 Study population
The target for this study was all male adults who were incarcerated at BSC from January 2014, only sentenced inmates diagnosed with TB from that period.
Friedman et al (2014) explain that the study population should be defined in advance, stating unambiguous inclusion or eligibility criterion. The impact that such criteria will have on study design, ability to generalize, and participant recruitment must be considered.

Inclusion criteria:

In order to ensure accurate inmates files are reviewed, key inclusion criteria were applied and they included the following:

- Male inmates, diagnosed with Tuberculosis and possess medical files;
- Inmates captured in the case finding from January 2014.

Exclusion criteria:

- Inmates, awaiting trial;
- Inmates who do not suffer from TB.

3.5 Sampling and sample Size

Based on the total estimation population of 3 415 people, all inmates who have TB with sample size of 385 (rounded to 400) inmates records, has been estimated using an expected theoretical prevalence of 7.5% (Barrairo, 2001; Niang et al, 2006).

All inmates who have been incarcerated at BCS from January 2014 to December 2015 will be eligible to be included in the study. Selection of files was randomly picked using a sampling interval 8.5 (3415/400, rounded to 9).

3.6 Validity and reliability assurance

As a study based on records review using a data collection forms, efforts were made to ensure that the data that were needed were collected. Experts from the Ethics Committees of the School and the University reviewed the forms and suggested corrections that were carried out. The institutional managers at the prisons also provided their inputs. The forms were pre-tested at the facilities using the period outside the defined study period. Few changes were made; mainly to remove the variables that could not be found on the records.
3.7 Bias minimisation
As a record review-based study, it was subjected to selection bias. Hence, a sampling interval was used to ensure randomness and heal was sought to ensure that the recorded selected were actually retrieved. Moreover, information bias due to missing data was reduced by removing altogether the variables whose information could be found on the records; and the help of relevant personnel was sought to decipher handwriting difficulties.

3.8 Data collection processing
The two data collections used can be found in Appendices (Annexures 1 and 2). The first form captured data on the number of inmates at the beginning and end of each month, those who were known TB patients, those who were newly diagnosed. The second form was designed to collect data on socio-demographic information such as age and gender. The other data such as ethnicity, race and educational level could not be obtained from the records. This form also captured data about the purpose of the study such as when the TB was diagnosed, how it was diagnosed, whether the person was on treatment, as well as the outcomes of treatment and other data.

3.9 Data Analysis
Data was captured in Excel and exported to Stata version 13. Categorical data were analysed as proportions and percentages while numeric data were analysed by determining their mean, median, and standard deviations. Inferential statistics will be done to estimate significance and a p-value of less than 0.05 will be regarded as statistically significant.

3.10 Ethical Consideration
The proposal was approved to the Sefako Makgatho University Research Ethics Committee (SMUREC) prior to the commencement of the study (Annexure 3) and the Ekhuruleni Ethics Committee (Annexure 4).
Chapter 4: Results

4.1 Introduction

This chapter presents the findings of this study, starting with a description of study participants and ending with a summary of key findings.

4.2 Socio-demographic data of the sample

All participants were males, aged 27 to 60 years old; their mean age was 43.5 ±9 years as shown in the following figure below.

![Figure 2: Age parameters of the sample (n=123)](image)

With regard to age category, the majority of subjects were 40 to 59 years old. The least affected were young adults aged 20 to 29 years old and those 60 years and above as shown below.
Table 1: Age categories of the sample

<table>
<thead>
<tr>
<th>Age category</th>
<th>Frequencies</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29 years old</td>
<td>7</td>
<td>5,7</td>
</tr>
<tr>
<td>30 to 39 years old</td>
<td>39</td>
<td>31,7</td>
</tr>
<tr>
<td>40 to 49 years old</td>
<td>43</td>
<td>35,0</td>
</tr>
<tr>
<td>50 to 59 years old</td>
<td>32</td>
<td>26,0</td>
</tr>
<tr>
<td>60 years and above</td>
<td>2</td>
<td>1,6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>123,0</strong></td>
<td><strong>100,0</strong></td>
</tr>
</tbody>
</table>

4.3 Clinical profile of study participants

4.3.1. Year diagnosed

The majority of participants were diagnosed in 2015, were the number of diagnosed was as much as that of the two preceding and successive years combined.

Figure 3: Year of diagnosis (n=123)
4.3.2. Method of Diagnosis

Roughly, two-thirds (60%) of participants were diagnosed by GeneXpert, the other, roughly one third by culture and the remaining 7 and 1% by x-ray or gene expert.

![Figure 4: Methods of diagnosis (n=123)](image-url)
4.3.3 Previous history with TB

The majority of inmates had no previous history of TB; only 9% were recorded as having had TB at the time they were incarcerated.

Figure 5: Percentage of patients with previous history of TB
4.3.4 Anatomical location of tuberculosis

Almost all inmates in this study (93%) had TB infection in the lungs; just 3% had extra-pulmonary TB.

![Figure 6: Anatomical location of TB infection in inmates (n=123)](image)

4.3.5 Patient registration status

Virtually all patients (99%) in the study were new patients.

![Figure 7: Patients registration status (n=123)](image)
4.3.5 HIV counselling and testing

Majority of the inmates (96%) were offered HTC.

Figure 8: Percentage of patients offered HCT (n=123)

4.3.6 HIV Status

Roughly, a third of participants were HIV-negative, and the remaining two-thirds were HIV-positive.

Figure 9: HIV status of inmates with TB (n=123)
4.3.7 Antiretroviral Treatment uptake

The figure below shows that the large majority (60%) of patients who were HIV-positive had started ART.

![Figure 10: Percentage of patients on ART (n=123)]

4.3.8 Isoniazid prevention uptake

Almost all the inmates (97%) were isoniazid prevention.

![Figure 11: Patients on Isoniazid (n=123)]
4.3.9 Cotrimoxazole prevention uptake

The majority of inmates, 82% of them, were on cotrimoxazole prevention.

![Figure 12: Patients on cotrimoxazole prevention (n=123)](image)

4.3.10 Regiment used

Majority, 97% of patients received a new adult regiment.

![Figure 23: Type of regiment used (n=123)](image)
4.3.11 Outcomes of treatment

The outcomes of TB treatment in the sample were good; overall, the success rate of treatment was 96% as 55% were confirmed cured and 41% having completed the cure.

![Pie chart showing treatment outcomes](image)

**Figure 34: Treatment outcomes (n=123)**

4.4 Trends in prevalence, incidence, and case fatality rates

Based on the total number of inmates and the number of TB cases at the beginning of 2014 and new cases recorded thereafter, the prevalence, incidence and case fatality rate were calculated.

The overall prevalence of TB during the 3-year period was 4.6%; it increased from 3.5% in 2014 to 7.1% in 2016. The incidence was 961 per 100,000 or 1% of inmates, ranging from 647 in 2014 to 797 per 100,000 in 2016.
Table 2: Trends of TB burden at BCS during the study period

<table>
<thead>
<tr>
<th>Number of TB cases per category</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>Average per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of existing cases at the start of the year</td>
<td>131</td>
<td>83</td>
<td>242</td>
<td>152</td>
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<tr>
<td>Number of new cases during the year</td>
<td>28</td>
<td>62</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Number of cases that died during the year</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Number of cases that were released during the year</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Number of cases that were transferred during the year</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Total number of cases</td>
<td>152</td>
<td>133</td>
<td>267</td>
<td>184</td>
</tr>
<tr>
<td>Total number of inmates at the end of the year</td>
<td>4327</td>
<td>4306</td>
<td>3762</td>
<td>4132</td>
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</tbody>
</table>

Measures of burden of TB

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>Average per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence (%)</td>
<td>3.5</td>
<td>3.1</td>
<td>7.1</td>
<td>4.6</td>
</tr>
<tr>
<td>Incidence per 100000 inmates per year</td>
<td>647</td>
<td>1440</td>
<td>797</td>
<td>961</td>
</tr>
<tr>
<td>Case fatality rate per 100000 inmates per year</td>
<td>92</td>
<td>70</td>
<td>53</td>
<td>72</td>
</tr>
</tbody>
</table>

The case fatality rate was on average 72 per 100,000 inmates; it went decreasing from 92 per 100,000 or 0.09% of inmates in 2014 to 53 per 100,000 or 0.05% in 2016.
4.5 Factors associated with TB

4.5.1. Bed occupancy and overcrowding

Data about the official bed capacity and the number of inmates at the facilities as at December 2016 are shown below:

Table 3: Boksburg prison occupancy data

<table>
<thead>
<tr>
<th>Prison Section</th>
<th>Beds official capacity</th>
<th>Actual number of inmates</th>
<th>Bed Shortage</th>
<th>Overcrowding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Juvenile</td>
<td>241</td>
<td>327</td>
<td>86</td>
<td>135%</td>
</tr>
<tr>
<td>Adults (Medium)</td>
<td>2051</td>
<td>4149</td>
<td>2098</td>
<td>202%</td>
</tr>
<tr>
<td>Total</td>
<td>2292</td>
<td>4476</td>
<td>2184</td>
<td></td>
</tr>
</tbody>
</table>

The table shows that overcrowding was serious in the adults section (202%) and moderate (135%) in the Juvenile section. Overall, there was a shortage of 2184 beds as compared to the official capacity of 2292 beds!
4.5.2 TB contact

The overwhelming majority (99%) of inmates with TB had been in contact with a TB infected person. In 97% of cases, this person was a cellmate.

![Figure 15: Percentage of patients in contact with a known TB infected person](image)

It is noted that risk factors could not be determined in a bivariate or multivariate analysis due to the missing counterfactual as data from inmates not infected could not be collected due to imposed restrictions.
4.5.3. Comorbidities

More than half of inmates suffered from comorbidities.

Table 4: Co-morbidities among inmates with TB at BCC

<table>
<thead>
<tr>
<th>Comorbidities</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV Only</td>
<td>63</td>
<td>51.2</td>
</tr>
<tr>
<td>No comorbidity</td>
<td>53</td>
<td>43.1</td>
</tr>
<tr>
<td>Diabetes only</td>
<td>2</td>
<td>1.6</td>
</tr>
<tr>
<td>HIV and Hypertension</td>
<td>2</td>
<td>1.6</td>
</tr>
<tr>
<td>Mental illness only</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>HIV and diabetes</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>HIV and Epilepsy</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>123</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The most common co-morbidity was HIV; and about 4% suffered from 2 more conditions besides TB.

4.6 Summary of results

The sample of study participants was made of only adult males with a mean age of 43 ± 9 years old. The most affected age groups were from 30 years to 49 years old.

Though the majority of them did not have a previous history of TB, they had been in contact with TB-infected cellmates; moreover, more than half of them were co-infected with HIV. With regard to the TB burden at this study site, the overall prevalence and incidence of TB during the 3-year period were 4.6% and 961 per 100,000 or 1% of inmates respectively. The prevalence increased from 3.5% in 2014 to 7.1% in 2016; while the incidence ranged from 647 in 2014 to 1440 in 2015 before decreasing to 797 per 100,000 in 2016. The case fatality rate decreased during the same period from 0.09% in 2014 to 0.05% in 2016.

Almost all patients suffered from pulmonary tuberculosis; they have been diagnosed, mainly, using GeneXpert, and had been provided with the essential interventions including
HCT, ART, and cotrimoxazole and isoniazid prophylaxis. They had been treated with regimen 1 as per the national TB treatment guidelines.

The outcomes of treatment were very encouraging, as more than half of inmates on treatment were confirmed cured, while 41% had completed their treatment.

With regard to factors that appear to play a role in the transmission of TB among inmates at this study site, it is noted that besides contact with an infected inmate, there was overcrowding, which ranged from 135% to 202%; and co-morbidities, mainly HIV.
Chapter 5: Discussion of Results and Conclusions

5.1 Introduction

This chapter discusses the findings of this study in the context of existing and previously published reports.

5.2 Profile of inmates with TB

The majority of people who were diagnosed with TB at the study site were all adult males aged 30 to 49 years old. This distribution is consistent with the age structure of the prison population in South Africa. Clinically, almost all of them were newly infected with pulmonary TB, more than half of them were co-infected with HIV, a well-established fact (WHO, 2016).

5.3 Prevalence and incidence of TB among inmates

The prevalence of TB among inmates at the study site during the study period was about 5% and appeared to be increasing due to the movement of inmates. The prevalence found in this study is within the range of 0.4 to 16% for Sub-Sharan Africa (Telisinghe et al, 2016). However, the figure of 4.6% is higher than the value of 3.5% previously reported by Telisinghe and co-workers (2014) but less than the figure reported in Cote d’Ivoire where a 9% has been reported among inmates (Seri et al, 2017). The incidence rate was very high in comparison to the general population. For instance, the figures of 647, 1440 and 797 per 100,000 were all higher than the corresponding national values of 593, 520, and 781 per 100,000 in the general population of South Africa for 2014, 2015 and 2016 respectively. It is interesting to note that while the incidence at the study site increased in 2014 at the study site,
nationally it actually decreased (TB Facts, 2016; WHO, 2016). It is important to note that, in comparison to the burden of TB in the Gauteng province where the study site is located, the incidence values found at the study site were at least 1.5 higher than the provincial values (Vanleeuw and Loveday, 2016). Moreover, this study’s finding confirms the well-established fact that burden of TB in prisons is always higher than in the general population (Telisinghe et al, 2016).

5.5 Factors associated with TB acquisition among inmates

Although risk factors could not be determined in a bivariate or multivariate analysis due to restrictions that hampered the collation of data from inmates not infected, the findings of this study show that the majority of inmates were not having active TB at the time of their incarceration; this finding supports the view that those who developed TB may have undergone this process while in prisons due to being in overcrowded prisons cells in contact with inmates who had active TB. It is not wise to conclude that people contracted TB in prisons latent TB is prevalent in South Africa. It is known that up to 88% of the South African is having latent TB (SANAC, 2012). The finding about overcrowding at this study site concurs with previous studies that have reported that the perennial problem of overcrowding as an exacerbating factor in the transmission of active TB in prisons (Harris et al, 2014; Todrys et al, 2011; Coker, 2005). It is interesting to note that the level of overcrowding at the study site was higher than the national average of 132% (World Prison Brief Data, 2018). Furthermore, with more than half of inmates with TB co-infected with HIV, its role as a factor in the acquisition of TB cannot be ruled out (Getahun et al, 2011; Mnisi and Govender, 2013).
5.6. Treatment outcomes and implementations of preventive measures

The study found that the outcomes of treatment were very encouraging, as more than half of inmates on treatment were confirmed cured, while 41% had completed their treatment. Clearly the success of the treatment is laudable and ushers optimism with regard to the management of TB in prisons. Moreover, prophylactic interventions such as the provision of HIV counselling and testing; isoniazid and cotrimoxazole have been implemented.

5.7 Limitations of the study

The above findings should be considered bearing in mind that this was a record review of cases; it is therefore not possible to establish causal links. Some data could not be found on the files reviewed such as some laboratory data, physical infrastructure data such as ventilation and state of windows.

5.8 Concluding remarks

The prevalence and incidence of TB among inmates at the study site were relatively high and showing an increasing trend.

Despite the presence of the ever-present overcrowding, it is laudable that the treatment success was very good and that preventive treatments such as cotrimoxazole and INH prophylaxis have been implemented.

5.9 Recommendations

The screening of inmates at incarceration should continue to be carried out so that people with no TB should be housed in appropriate cells.
A surveillance program to identify inmates TB should be instituted so that inmates found with active TB should be separated from the others until they become non-infectious after at least 2 months of treatment.

More studies utilising other study designs such as case-control and cohort studies should be conducted so that risk factors for TB in prisons and the true incidence of TB in correctional services facilities can be calculated.

REFERENCES


WHO. (2007). Health in Prisons, A guide to the essentials in in prison health, to care for prisoners in need and to promote the health of prisoners and prison staff.


### Annexure 1: Prevalence and incidence data

#### Year 2014

<table>
<thead>
<tr>
<th>Categories of patients and movement</th>
<th>Jan-14</th>
<th>Feb-14</th>
<th>Mar-14</th>
<th>Apr-14</th>
<th>May-14</th>
<th>Jun-14</th>
<th>Jul-14</th>
<th>Aug-14</th>
<th>Sep-14</th>
<th>Oct-14</th>
<th>Nov-14</th>
<th>Dec-14</th>
<th>Total</th>
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<tbody>
<tr>
<td>Number of TB Patients at end of month</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>7</td>
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<td>15</td>
<td>14</td>
<td>13</td>
<td>16</td>
<td>18</td>
<td>21</td>
<td>131</td>
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<tr>
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<td>3</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>7</td>
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<td>16</td>
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<td>7</td>
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<td>13</td>
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#### Year 2015

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<td>3</td>
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#### Year 2016

<table>
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<tr>
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<th>Feb-16</th>
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<tr>
<td>Number of TB Patients at end of month</td>
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<td>Number of new cases during the month</td>
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<td>4</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Number of cases that died</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Number of cases that were released</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Number of cases that were transferred</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Number of inmates with TB</td>
<td>12</td>
<td>16</td>
<td>17</td>
<td>19</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>22</td>
<td>25</td>
<td>31</td>
<td>32</td>
<td>33</td>
<td>267</td>
</tr>
<tr>
<td>Total Number of inmates at BCCS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3762</td>
</tr>
</tbody>
</table>
## Annexure 2: Data collection form

### Prevalence of TB amongst inmates in Boksburg Correctional service

#### Patient Registration

Registration Date ____________________  
Facility ___________________________  
District ________________

#### Part 1: Patient profile

1. Gender  
   - Male □  
   - Female □  
   - Other □

2. Age in years (Print): ________________

3. Weight value:  
   - < 50 □  
   - >50 □

4. Patient category
   
   - New □  
   - Re Rx after cure □  
   - Rx after failure □  
   - Rx after default □

5. Patient Registration Type
   
   - New □  
   - Moved in □  
   - Transfer in □

6. TB contact
   
   - None □  
   - Family member □  
   - Girlfriend/Partner □  
   - Other ___________

7. Next of kin recorded:  
   - Yes □  
   - No □

8. Is the patient Notified:  
   - Yes □  
   - No □
**Part 2: Disease Profile and risk factors**

1. When was TB diagnosed? Month:___________ Year________

2. How was the diagnosis made?
   - Smear ☐
   - Culture ☐
   - Gene expert ☐
   - Xray ☐

3. Disease classification: Pulmonary TB ☐
   - Extrapulmonary TB ☐

4. Regimen: 1. New adult ☐
   - 2. Re Rx adult ☐
   - 3. other ☐

5. Previous History of TB: Yes ☐
   - No ☐

6. Was HCT offered? Yes ☐
   - No ☐


8. If yes CD4 value: <200 ☐
   - >200 ☐

9. HIV status: Pos ☐
   - Neg ☐
   - Unknown ☐

10. If HIV-positive, is the patient started on ART? 1. Yes 2. No

11. Drug side effects:
   - Yes ☐
   - No ☐
   - not known ☐

12. Treatment outcome: Rx completed ☐
   - Rx cured ☐
   - Died on Rx ☐
   - Defaulted ☐

13. On CPT: Yes ☐
   - No ☐

14. On IPT: Yes ☐
   - No ☐

15. Is adherence data recorded on file? 1. Yes 2. No

16. If yes, what is the adherence level recorded? ____________%

17. Has this patient suffered from other Medical conditions? 1. Yes 2. No

18. If yes, which ones?_____________________

19. Treatment Support 1. Yes 2. No

20. Is the inmate sharing a cell? Yes ☐
   - No ☐

21. Smoking, needle sharing (drug use) Yes ☐
   - No ☐
   - Unspecified ☐
Annexure 3: Ethics Clearance Certificate

Sefako Makgatho Health Sciences University
Research & Postgraduate Studies Directorate
Sefako Makgatho University Research Ethics Committee
(SMUREC)

Molotla Street, Ga-Rankuwa 0208
Tel: (012) 521 5617/3698 fax: (012) 521 3749
Email: lorato.phiri@smu.ac.za
P.O. Box 163 Medunsa 0204

APPROVAL NOTICE - NEW APPLICATION

06 October 2016

Mrs NM Tootetsei
Department of Public Health
P.O Box 215
Medunsa, 0204

MEETING: 08/2016

SMUREC Ethics Reference Number: SMUREC/H249/2016: PG

The New Application received on 26 August 2016, was reviewed by members of Sefako Makgatho University Research Ethics Committee 06 October 2016 and was approved on 06 October 2016.

Title: Prevalence and risk factors of tuberculosis amongst inmates in Bosakrug Correctional Services

Researcher: Mrs NM Tootetsei
Supervisor: Prof NG Masinga
Department: Public Health
School: Health Care Sciences
Degree: MPH

Please note the following information about your approved research protocol:

Protocol Approval Period: 06 October 2016 – 06 October 2017

Please remember to use your protocol number (SMUREC/H249/2016: PG) on any documents or correspondence with the REC concerning your research protocol.

Please note that the REC has the prerogative and authority to ask further questions, seek additional information, require further modification, or monitor the conduct of your research and the consent process.

After Ethical Review: Please note a template of the progress report is obtainable in the Research Office and should be submitted to the Committee before the year has expired. The Committee will then consider the continuation of the project for a further year if necessary. Annual a number of projects may be selected randomly for an external audit. Translation of the consent document in the language applicable to the study participants should be submitted.

International Organisation (IORG0008691), Institutional Review Board (IRB000010380) Expiry date: 09 December 2018, Federal Wide Assurance (FWA000023943) Expiry date: 31 August 2017 and NHREC No: REC 210408-003

Sincerely

[Signature]

DR C BAKER
DEPUTY CHAIRPERSON SMUREC

International Organisation (IORG0008691), Institutional Review Board (IRB000010380) Expiry date: 09 December 2018, Federal Wide Assurance (FWA000023943) Expiry date: 31 August 2017 and NHREC No: REC 210408-003

[Signature]

Date: [Date]

Chairperson
SMU Research Ethics Committee
Annexure 4: Ekhurhuleni Ethics Clearance Certificate

EKURHULENI RESEARCH CLEARANCE CERTIFICATE

Research Project Title: Prevalence and risk factors of tuberculosis amongst inmates in Boksburg Correctional Service.

Research Project Number: 08/12/2016-6

Name of Researcher(s): Ms Mildred Tsotetsi

Division/Institution/Company: Sefako Makgatho Health Sciences University

DECISION TAKEN BY THE EKURHULENI HEALTH DISTRICT RESEARCH COMMITTEE (EHDRC)

- THIS DOCUMENT CERTIFIES THAT THE ABOVE RESEARCH PROJECT HAS BEEN FULLY APPROVED BY THE EHDC. THE RESEARCHER(S) MAY THEREFORE COMMENCE WITH THE INTENDED RESEARCH PROJECT.

- NOTE THAT THE RESEARCHER WILL BE EXPECTED TO PRESENT THE RESEARCH FINDINGS OF THE PROPOSED RESEARCH PROJECT AT THE ANNUAL EKURHULENI RESEARCH CONFERENCE.

- THE RESEARCH COMMITTEE WISHES THE RESEARCHER(S) THE BEST OF SUCCESS.

DEPUTY CHAIRPERSON: EKURHULENI METROPOLITAN MUNICIPALITY
Dated: 14/10/2016

CHAIRPERSON: GAUTENG DEPARTMENT OF HEALTH (EKURHULENI REGION)
Dated: 14/12/2016.