

# Experiences of Community Health Nurse Specialists in the Tuberculosis Burden Setting

**Granny Tshabane M. Motswasele**  
<https://orcid.org/0000-0002-8642-5506>  
 SG Lourens Nursing College, South Africa  
 tshabanemotswasele14@gmail.com

**Mamphego Doriccah Peu**  
<https://orcid.org/0000-0002-1585-2404>  
 University of Pretoria, South Africa  
 Doriccah.peu@up.ac.za

**Salamina S. Moloko-Phiri**  
<https://orcid.org/0000-0001-5129-5564>  
 North-West University, South Africa  
 16445198@nwu.ac.za

## Abstract

South Africa is one of the countries with the highest tuberculosis (TB) burden. The World Health Organization (WHO) statistics gave an estimated incidence of 322 000 cases of active TB in 2017. Furthermore, according to the WHO, an estimated 78 000 people in South Africa died from TB. The National Strategic Plan for HIV, TB and STIs identified the Gauteng province in South Africa as one of the districts with a high TB burden; a decision informed by annual measurements of TB incidence, prevalence and mortality. The main objective of the study was to explore and describe the experiences of community health nurse specialists in the TB burden setting to ensure safe practices and excellent service delivery. A qualitative descriptive phenomenological design was used to describe the experiences of community health nurse specialists in the TB burden setting. A purposive sampling method was used to select 20 nurses. Ethical principles were adhered to and trustworthiness strategies were applied throughout the study. The data were collected through in-depth interviews and analysed using the 7 steps of Colaizzi's method of data analysis. The findings indicated that community health nurse specialists are afraid of being infected with TB, and that patients who default treatment are of concern. The services of prevention, treatment, care and support needed by these nurses should be prioritised by the relevant management to ensure that service delivery is not compromised.



Africa Journal of Nursing and Midwifery  
<https://upjournals.co.za/index.php/AJNM/index>  
 Volume 22 | Number 1 | 2020 | #6383 | 16 pages

<https://doi.org/10.25159/2520-5293/6383>  
 ISSN 2520-5293 (Online), ISSN 1682-5055 (Print)  
 © Unisa Press 2020



Published by Unisa Press. This is an Open Access article distributed under the terms of the Creative Commons Attribution-ShareAlike 4.0 International License (<https://creativecommons.org/licenses/by-sa/4.0/>)

**Keywords:** community health nurse specialist; tuberculosis; TB burden setting; phenomenology

## Introduction/Background

Tuberculosis (TB) remains one of the most life-threatening conditions among many infectious diseases. In 2011, it was the second leading cause of death globally (Mabunda and Bradley 2011, 93). In 2013, an estimated 9 million people were infected with TB, while 1.5 million died from the disease (WHO 2014, 13). Dirlikov, Raviglione, and Scano (2015, 1) concur with the World Health Organization (WHO 2014, 13) that effective diagnosis and treatment influenced a decline in TB incidence cases between 2000 and 2013. Globally, in 2017, an estimated 10 million people developed TB while 1.3 million people died from TB (WHO 2018, 12). However, considering the fact that TB-related deaths are preventable, the current TB mortality rate is of concern. Therefore, effective and affordable interventions by healthcare workers are vital to prevent further transmission of the disease and loss of lives.

In South Africa, the low socio-economic status and the HIV epidemic influenced the increase of TB incidence cases, as indicated in the National Strategic Plan (NSP) for HIV, TB and sexually transmitted infections (STIs) (SANAC n.d a). To reduce the transmission of TB effectively among healthcare workers and communities, the period of infectiousness has to be kept to a minimum through early diagnosis and treatment, a view echoed by Lönnroth et al. (2010, 1820). Disappointingly, the National Tuberculosis Programme (NTP) that was established in 1994, failed to reduce the TB burden in South Africa that was crippling the health services and more people got infected with TB (Churchyard et al. 2014, 245). To curb the TB epidemic, the South African Department of Health developed an integrated NSP for HIV, TB and STIs (SANAC n.d a). The NSP aimed at reducing the TB prevalence and mortality by 2016. These targets would be achieved through effective TB diagnosis, treatment and the prevention of transmission.

In 2010, the WHO endorsed the use of GeneXpert for the rapid and accurate detection of TB (Piatek et al. 2013, 19). Unfortunately, the unavailability of cartridges for the test remains an obstacle to achieving the goal of rapid TB diagnosis. Patients diagnosed with TB receive free treatment, but adherence to the strict drug regimen is still a challenge, thus spreading the infection (Adane et al. 2013, 2). The prevention of TB transmission among populations at risk, such as healthcare workers, should be optimised to ensure a healthy working environment (Loveday, Smith, and Day 2013, 144).

Healthcare workers are at a continued risk of contracting TB while providing care to patients with undetected TB (Engelbrecht et al. 2015, 1). Inadequate control measures for TB infections and the individual susceptibility exacerbate the transmission of infection from patients to healthcare workers (Ukwaja, Alobu, and Onu 2013, 1). The

infection control programme must include screening of healthcare workers for latent TB thereby identifying the need for commencing treatment.

It is further noted that healthcare workers prefer to take treatment secretly so that they are not stigmatised and discriminated against by colleagues and the community (Von Delft et al. 2015, 148–149). It is therefore important that periodic screening of healthcare workers for latent TB be done. Education on TB-related stigma may encourage healthcare workers diagnosed with TB to disclose their status and receive support from their colleagues.

Community health nurse specialists diagnosed with TB are often concerned about being fatally ill and hospitalised for a lengthy period. The community health nurse specialists as participants provide care to people diagnosed with TB in facilities that have low staff ratios with increased workloads and responsibilities exposing them to TB infection (Zelnick et al. 2013, 1). They therefore develop a psychological defence as a coping mechanism because they are rightfully afraid of being infected with TB (Von Delft et al. 2015, 148). The aim of this study therefore was to explore and describe the experiences of community health nurse specialists in the TB burden setting in order to improve healthcare services in the Tshwane sub-district of the Gauteng province in South Africa.

## Problem Statement

The South African government continues to make efforts to fight TB as set out in its NSP for HIV, TB and STIs (SANAC n.d a). The introduction of the pro-active identification measure of TB and testing using GeneXpert was one of the strategies to combat the disease. However, an estimated 150 000 people with TB remain undiagnosed. Many people with TB symptoms are uninformed of their TB status, face undesirable delays between TB diagnosis and the start of treatment, and discontinue or are unable to complete TB treatment (SANAC n.d b).

The late presentation to health facilities by patients with TB symptoms also contributes to the spread of TB. According to the NSP for HIV, TB and STIs (SANAC n.d b), healthcare workers are also listed as one of the key groups that are more likely to be exposed to TB or to transmit the disease.

The results of this study could provide insight related to experiences of community health nurse specialists working in the TB burden setting. This is a setting where the TB incidence, prevalence and mortality are measured annually (WHO 2018, 39). Additionally, it could afford a viewpoint to the type of services of prevention, treatment, care and support needed by these nurses. It is imperative that the relevant management prioritise identified services to nurses so that the provision of excellent patient care is not compromised.

## Purpose of the Study

The specific objective of the study was to explore and describe the experiences of community health nurse specialists who work in TB burden settings in the selected clinics of the Tshwane sub-district of Gauteng to identify services of prevention, treatment, care and support needed by these nurses.

## Research Methodology

The researcher followed a qualitative descriptive phenomenological approach and focused on the experiences of community health nurse specialists who work in TB burden settings. The descriptive phenomenological approach was chosen with the intention of describing a particular phenomenon or the appearance of things as lived experiences, which in this study are the lived experiences of community health nurse specialists who work in a TB burden setting (Streubert and Carpenter 2011, 73). In the current study, the researcher identified community health nurse specialists as the sole participants who work in the TB burden setting to describe their own awareness of the situation. Furthermore, the participants were encouraged to share details regarding their experiences.

## Study Area and Population

The study was conducted in three clinics in the Tshwane sub-district of Gauteng. According to the District Health Barometer 2015/16 (Massyn et al. 2016), Gauteng, eThekweni and Cape Town were categorised as the three districts with the highest TB burden in South Africa. Annual measurements of the TB incidence, prevalence and mortality are used to confirm if a district has a high TB burden or not (WHO 2018). Purposive sampling of 20 nurses who met the inclusion criteria and who were working in the three selected clinics was used. Male and female community health nurse specialists who worked in the three identified clinics for a minimum of two years consented to participate in the study.

## Data Collection

An unstructured individual interview was selected as the data collection method. The interviews are collaborative in nature and controversial because the researcher cannot predict the outcome (Polit and Beck 2012, 536). The interviews were tape recorded and were informed by the interview guide. The researcher listened attentively to what was shared by the participants, and asked follow-up questions for clarity. The participants were also observed for non-verbal cues so as to capture all the necessary information shared. The researcher observed the participants for emotional distress for prompt referral to the employee wellness centre that was earlier notified of such referrals. An open-mind attitude was maintained by the researcher who also bracketed own beliefs and values to avoid being prejudgemental.

## Ethical Considerations

Ethical considerations were adhered to in the following manner: The research proposal was submitted to the Research Ethics Committee of the Faculty of Health Sciences at the University of Pretoria for approval before starting with the actual research. Permission to conduct the study was sought from the Gauteng Provincial Department of Health and the management of the selected clinics in the Tshwane sub-district of Gauteng.

## Research Results

The results were grouped into themes and sub-themes. Two themes and six sub-themes emerged from the transcripts. The results were based on the experiences of the participants as shared in their own voices.

**Table 1:** Themes and sub-themes on the experiences of community health nurses in the TB burden setting

Theme	Sub-theme
Fear of being infected with TB	<ul style="list-style-type: none"> <li>• Delayed diagnosis of TB patients</li> <li>• Lack of knowledge among TB patients</li> <li>• Staff with chronic diseases</li> </ul>
Infection control	<ul style="list-style-type: none"> <li>• Protective masks</li> <li>• Open window/door policy</li> <li>• TB-infected staff members</li> </ul>

### Theme 1: Fear of being infected with TB

It became apparent that the community health nurse specialists who work in the TB burden setting were scared of being infected with TB. Challenges such as the delay in diagnosing TB patients and lack of knowledge among TB patients contribute to the likelihood of community health nurse specialists being infected with TB.

#### *Delayed diagnosis of TB patients*

The patients' TB status is usually confirmed during the subsequent consultation; thus, community health nurse specialists unknowingly interact with TB patients during their initial visit. The community health nurse specialists are mindful of the fact that in some instances patients that come into their consulting rooms may not provide their precise history that could inform TB investigations, and therefore the patients may be misdiagnosed. The patients return to the clinic if medication received earlier is not effective. It is during the second visit that the nurse recognises the need for TB investigation and relevant management, as is evident in the following quote:

It is risky to work in a TB burden setting. Some patients arrive at the clinic, not coughing, complaining of minor ailments but meanwhile they are TB positive and not on treatment. After several clinics visits a healthcare worker suspects TB infection, sputum is collected, and results come back positive and treatment is commenced. (Clinic 3 P 9)

Another community health nurse specialist said:

Working in a TB environment is risky because results are only made available after a healthcare worker had been in contact with an undiagnosed TB patient more than once. (Clinic 2 P 14)

The community health nurse specialists expressed concern of being infected with TB after patients they interacted with earlier are TB positive, a notion supported by Verkuijl and Middelkoop (2016, S235). The lack of protection from TB infection was highlighted by community health nurse specialists. To support these findings Sreeramareddy et al. (2014, 255) discovered that delayed diagnosis of TB could enhance the transmission of infection, worsen the disease and increase the risk of death.

The participants mentioned that patients who arrive at the clinic sit around while waiting for their files, then proceed to the vital signs area, and then wait to be called into the consultation room. The nurses are constantly interacting with patients in the clinic, even patients with multidrug resistant TB who are not on treatment. Furthermore, the participants stated that in the consulting rooms, after history taking, suspicious patients are identified, and the relevant investigations carried out. These findings are consistent with the study conducted by Von Delft et al. (2015, 149) who assert that the bulk of TB transmission in healthcare centres occurs before a diagnosis can be made.

#### *Lack of knowledge among TB patients*

TB patients' inadequate knowledge about the disease impedes the effectiveness of infection control measures aimed at preventing the transmission of TB infection. Community health nurse specialists revealed that, even though TB patients are taught cough etiquette, patients display insufficient knowledge about the disease. Such behaviour may expose community health nurse specialists to TB infections. During the study, it was revealed that some patients who defaulted on their TB treatment after being diagnosed with multidrug-resistant TB do return to the clinic when they are sick. However, the patients do not divulge their TB status as it would suggest immediate referral to the TB room for investigation and further management. The patients interact with nurses and other patients, exposing them to TB infection. The following quotes verify these findings:

The patient does not inform family about his TB status, neither does he practice cough etiquette. The used tissues are thrown anywhere, not disposed of properly. The TB patient is not knowledgeable about how TB is transmitted from one person to the other.

The patient is only worried about being “diagnosed with HIV” if his TB status is known by family. (Clinic 3 P 8)

Patient arrives in the clinic labour ward, ready for delivery. The patient does not know the importance of informing the healthcare worker about her TB status and that she did not take treatment during pregnancy. She only informs the healthcare worker that she is TB positive during postnatal care. (Clinic 3 P 16)

The study revealed that the refusal to wear masks is a sign of lack of knowledge among TB patients. The participants indicated that TB patients’ unwillingness to practice cough etiquette combined with the refusal to wear a protective mask during interaction with healthcare workers provided a prime setting for the rapid spread of TB. The findings are in line with those of Gonzalez-Angulo et al. (2013, 717), who discovered that there is limited knowledge about TB transmission and prevention among patients.

The participants communicated that ignorance among TB patients about the mode of TB transmission needs attention as an urgent measure to improve aspects of TB infection control.

In the current study the findings further brought to light that TB patients have an impression that using a protective mask is a sign of discrimination and not prevention of TB transmission. The inference here is that patients are unable to appreciate the importance of TB infection control measures due to a lack of knowledge about the disease. In support of these findings, Bulage et al. (2014:9) found that patients received insufficient information about TB from healthcare workers and were not aware of the possibility of transmitting the infection to others. In further support of the findings, a study conducted in Ethiopia revealed that TB patients who know little about the disease will not refrain from transmitting the TB infection to others (Tolossa, Medhin, and Legesse 2014, 1). The study recommendations included that health education be aimed at achieving a noteworthy change in the knowledge about TB.

The study findings were clear that TB patients lack knowledge about the disease. The participants shared that some patients do not reveal that they are TB positive and not taking treatment because TB is associated with HIV. The participants pointed out that patients cough without covering their mouths while sitting close to healthcare workers. In support of this finding, Gizaw, Alemu, and Kibret (2015, 2) highlighted that interaction between undiagnosed patients with TB and community health nurse specialists leads to prolonged exposure that will increase TB transmission. Tudor et al. (2013, 25) discovered that healthcare workers are concerned about TB patients’ behaviour such as the failure to practice proper cough etiquette. The participants assert that, since TB infection is airborne, coughing patients who do not cover their mouths increase the possibility of TB transmission from patient to healthcare worker. This affirms the notion that patients lack knowledge of how TB is transmitted.

### *Staff with chronic diseases*

The participants cited a concern about being infected with TB as a chronic disease because they suffer from other chronic diseases. They are compliant with taking medication but some chronic diseases compromise persons' immune systems, thus making them vulnerable to infections. The participants expressed their concerns in relation to suffering from a chronic disease:

A staff member, who was on treatment for diabetes mellitus contracted TB. She was placed on treatment but regrettably she passed on. The nurse was asked to prove beyond doubt that she contracted the disease at work. (Clinic 1 P 4)

Sometimes the healthcare worker is not aware that she is HIV positive, some nurses refuse to test for HIV thus one can easily interact with undiagnosed TB patients while her immune system is compromised. (Clinic 3 P 10)

The participants shared an important factor that was related to staff members with chronic diseases being prone to infections. They further alluded that one staff member was diagnosed with diabetes mellitus and while on treatment contracted TB. The staff member unfortunately passed on. Kumar et al. (2013, 2) report that diabetes mellitus is a risk factor for the development of active TB. Furthermore, the authors attest that diabetes reduces positive TB treatment outcomes by increasing the risk of recurrent disease after treatment was successfully completed.

The participants confirmed that TB is one of the opportunistic diseases faced by people living with chronic diseases such as diabetes mellitus. The participants further noted that healthcare workers diagnosed with diabetes mellitus are at a high risk of acquiring TB from patients with TB. It was evident from the findings that the participants felt strongly that healthcare workers with chronic diseases such as HIV are more susceptible to TB. The implication is that HIV exposes a person to many infections, one of which is TB. Tudor et al. (2016, S259) argued that the risk of contracting TB is greater in individuals living with HIV. The participants shared that healthcare workers living with HIV interact with undiagnosed TB patients in the consulting rooms. The compromised immune system of the healthcare worker increases the risk of contracting TB from the patient.

### **Theme 2: Infection Control**

Infection control emerged as the second theme. Inadequate infection control measures influence the risk of transmission among TB patients and nurses. Access to information on TB influences the nurses' behaviour and attitudes regarding TB infection. The participants stated that, even though they were aware of the importance of compliance with infection control measures, they sometimes compromised such measures.



### *Protective masks*

Airborne infections pose a threat to community health nurse specialists whenever they are together in consultation rooms with patients coughing up the TB bacilli. In this study, the participants indicated that they do not wear protective masks because they are uncomfortable to wear. The participants relied on their skills to identify a patient who is a TB suspect, meaning, they know when to wear a protective mask. The following quotes indicate that participants are compromising infection control measures by not wearing protective masks:

In the TB room, I am expected to wear a protective mask, I do not wear a mask because it is uncomfortable, I feel like I am suffocating when wearing a mask, I cannot breathe properly. (Clinic 3 P 11)

I do not wear a protective mask; it creates a 'wall' between the patient and me. It gives an impression that the patient has a bad odour, thus the relationship between the patient and me suffers resulting in the patient not being forthcoming during history taking. (Clinic 2 P 18)

The participants stated that they are unable to use protective masks consistently because the available masks are uncomfortable to wear. Verkuijl and Middelkoop (2016, S233) are in agreement after pursuing an investigation in relation to the occupational TB prevention through infection control strategies. These authors concluded that healthcare workers are aware of the increased risk of acquiring TB infection due to the failure to wear protective masks regularly. Community health nurses as participants mentioned that discomfort is a reason for non-compliance with protective masks. The participants further confirmed that wearing a protective mask is so uncomfortable and it makes them feel like they are suffocating. Furthermore, the participants stated that the masks disturb communication between nurses and patients and also that patients may perceive nurses as lacking empathy.

Some participants stated that even though they are aware of the importance of wearing a protective mask when attending to patients, the practice is sometimes not realistic in the maternity section of the clinic. Sometimes patients arrive in the unit ready to deliver the baby leaving no time for the healthcare worker to put on a mask. Furthermore, the participants indicated that after delivery TB screening is done, and if the patient is TB positive the healthcare worker only then realises the extent of TB infection exposure.

The participants indicated that they find wearing a protective mask as a challenging process because the mask creates a "wall" between the healthcare worker and the patient. Ineffective communication between the healthcare worker and the patient has an impact on the successful history taking; the healthcare worker may fail to collect the relevant information from the patient. Similarly, Brouwer et al. (2014, 9) shared that the use of a protective mask has an isolating or depersonalising effect. The authors added

that the use of protective masks reduce the healthcare worker's ability to provide compassionate care to the patient.

### *Open window/door policy*

The participants agreed that one of the infection control measures mostly adhered to is the open window/door policy. They cited that directing airflow and circulation minimises the transmission of TB. The participants' verbatim quotes regarding the open window/door policy are as follows:

To minimise transmission of TB from patients to nurses we practice open door/window policy to accelerate free flow of air. (Clinic 3 P 9)

As a means of protection against TB, I practice open door/window policy to speed up cross ventilation thus minimise transmission of TB from patients to nurses. (Clinic 3 P 11)

The participants mentioned that among the available infection control measures, the open door/window policy is mostly practised. They emphasised that the policy is even practised during winter months to ensure consistency in minimising transmission of TB. Brouwer et al. (2015, 48) conducted a study on the implementation of TB infection prevention in Mozambique and found that natural ventilation has good potential to reduce airborne transmission. Brouwer et al. (2015, 48) further added that opening doors and windows is one of the easy ways to implement infection control measures to reduce TB transmission in healthcare facilities.

The general use of open doors and windows to prevent TB transmission came up strongly from the participants. The participants stated that the doors and windows are opened to speed up cross ventilation, thus reducing the transmission of TB from patients to healthcare workers. The notion concurs with the findings of Mohajan (2014, 11) that maximising natural ventilation by opening doors and windows may decrease the risk of TB transmission.

According to the findings of this study, the participants practiced the open door/window policy to accelerate free airflow, as a means of protection against TB infection. Yuen et al. (2015, 2341) agreed, and added that opening doors and windows in healthcare facilities to decrease TB transmission is an infection control measure that is easy to implement.

### *TB infected staff members*

The participants confirmed that people with undiagnosed and untreated TB arrive at the health centre on a regular basis and this increases the risk of TB transmission. Furthermore, the participants expressed the lack of protection from TB infection as a concern especially because they are exposed to TB infection while at work. They said:

A colleague sent sputum for investigation and the results were positive. I do not know if she contracted TB at work or somewhere else. (Clinic 1 P 3)

I contracted TB after being in contact with four MDR patients. Lack of space and unavailability of N95 masks are the reasons I got infected with TB. (Clinic 1 P 4)

The findings of the current study revealed that staff members are diagnosed with TB but, unfortunately, it is difficult to prove that they were infected at work. Some participants highlighted the need for compensation when a nurse has been infected with TB as stipulated in the Compensation for Occupational Injuries and Diseases Amendment Act, 1997 (Act No. 61 of 1997). Furthermore, it became evident that nurses diagnosed with TB do not receive support from the management. Psychological support was viewed as being of more value than compensation. The study conducted by Adams et al. (2015, 8) discovered that healthcare workers are likely to become infected with TB. The authors further pointed out that the yearly rate of TB infections in South Africa is very high owing to occupational exposure.

The findings of this study also reflected that healthcare workers are infected with TB but, unfortunately, they are not able to prove beyond reasonable doubt that they contracted TB at work. A participant aptly verbalised that a healthcare worker contracted TB after being in contact with four multidrug-resistant patients. The community health nurse was convinced that this was sufficient evidence that TB was contracted at work, but was declined by the clinic management. Nienhaus et al. (2014, 9) reported that a healthcare worker in contact with a TB patient is at risk of TB infection, and therefore contracting the disease. In addition, Nienhaus et al. (2014, 9) assert that TB in a healthcare worker can only be accepted as occupational disease if an increased work-related risk of infection can be established and if there is no risk of TB infection outside work.

Claassens et al. (2013, 5) found that the TB incidence rate is higher among healthcare workers than among the general population. Furthermore, the incidence of occupational TB among healthcare workers in South Africa is of concern. The study findings highlighted that a healthcare worker without TB symptoms was diagnosed with TB during screening. In addition, another healthcare worker was infected with TB, received treatment and was re-infected again. These findings further affirm the high risk of TB transmission among healthcare worker owing to occupational exposure. Therefore, the implementation of infection control measures is the responsibility of all healthcare workers.

## Conclusion

Various experiences of the participants focused on the fears of being infected with TB and infection control. The failure to wear protective masks and then the fear of contracting TB was attributed to delayed diagnosis of TB patients, and patients'

ignorance regarding TB transmission. Several participants revealed compromised TB infection control measures.

## Recommendations

The services of prevention, treatment, care and support needed by community health nurse specialists in the TB burden setting should be prioritised by the relevant management; this will assist the nurses to provide excellent healthcare services to patients.

## Limitations of the Study

The study was conducted in one province only (Gauteng). The possibility of the findings being different if the study was conducted in other provinces and more rural setting is not disputed.

## Acknowledgements

The first author would like to express gratitude to the University of Pretoria, the Tshwane Health District for permission to conduct the study, the community health nurses specialists in the three selected clinics in the Tshwane sub-district of Gauteng for participating in this study, Prof. M. D. Peu and Prof. S. S. Moloko-Phiri for their mentorship and encouragement, and Mr D Sonnekus for the editing services.

## References

- Adams, S., R. Ehrlich, R. Baatjies, R. N. van Zyl-Smit, Q. Said-Hartley, R. Dawson, and K. Dheda. 2015. "Incidence of Occupational Latent Tuberculosis Infection in South African Healthcare Workers." *European Respiratory Journal* ERJ-01384. <https://doi.org/10.1183/09031936.00138414>.
- Adane, A. A., K. A. Alene, D. N. Koye, and B. M. Zeleke. 2013. "Non-Adherence to Anti-Tuberculosis Treatment and Determinant Factors among Patients with Tuberculosis in Northwest Ethiopia." *PloS one* 8 (11): e78791. <https://doi.org/10.1371/journal.pone.0078791>.
- Brouwer, M., E. Coelho, C. das Dores Mosse, and F. van Leth. 2015. "Implementation of Tuberculosis Infection Prevention and Control in Mozambican Health Care Facilities." *International Journal of Tuberculosis and Lung Disease* 19 (1): 44–49. <https://doi.org/10.5588/ijtld.14.0337>.

- Brouwer, M., E. Coelho, C. das Dores Mosse, L. Brondi, L. Winterton, and F. van Leth. 2014. "Healthcare Workers' Challenges in the Implementation of Tuberculosis Infection Prevention and Control Measures in Mozambique." *PloS one* 9 (12): e114364. <https://doi.org/10.1371/journal.pone.0114364>.
- Bulage, L., J. Sekandi, O. Kigenyi, and E. Mupere. 2014. "The Quality of Tuberculosis Services in Health Care Centres in a Rural District in Uganda: The Providers' and Clients' Perspective." *Tuberculosis Research and Treatment*. <https://doi.org/10.1155/2014/685982>.
- Churchyard, G. J., L. D. Mametja, L. Mvusi, N. Ndjeka, A. C. Hesselning, A. Reid, S. Babatunde, and Y. Pillay. 2014. "Tuberculosis Control in South Africa: Successes, Challenges and Recommendations." *South African Medical Journal* 104 (3): 234–48. <https://doi.org/10.7196/SAMJ.7689>.
- Claassens, M. M., C. van Schalkwyk, E. du Toit, E. Roest, C. J. Lombard, D. A. Enarson, N. Beyers, and M. W. Borgdorff. 2013. "Tuberculosis in Healthcare Workers and Infection Control Measures at Primary Healthcare Facilities in South Africa." *PloS one* 8 (10): e76272. <https://doi.org/10.1371/journal.pone.0076272>.
- Dirlikov, E., M. Raviglione, and F. Scano. 2015. "Global Tuberculosis Control: Toward the 2015 Targets and Beyond Global Tuberculosis Control: Toward the 2015 Targets and Beyond." *Annals of Internal Medicine* 163 (1): 52–58. <https://doi.org/10.7326/M14-2210>.
- Engelbrecht, M., A. van Rensburg, A. Rau, A. Yassi, J. Spiegel, L. O'Hara, E. Bryce, and L. Nophale. 2015. "Tuberculosis and Blood-Borne Infectious Diseases: Workplace Conditions and Practices of Healthcare Workers at Three Public Hospitals in the Free State." *Southern African Journal of Infectious Diseases* 30 (1): 23–28. <https://doi.org/10.1080/23120053.2015.1103958>.
- Gizaw, G. D., Z. A. Alemu, and K. T. Kibret. 2015. "Assessment of Knowledge and Practice of Health Workers towards Tuberculosis Infection Control and Associated Factors in Public Health Facilities of Addis Ababa, Ethiopia: A Cross-Sectional Study." *Archives of Public Health* 73 (1): 15. <https://doi.org/10.1186/s13690-015-0062-3>.
- Gonzalez-Angulo, Y., H. Geldenhuys, D. van As, N. Buckerfield, J. Shea, H. Mahomed, W. Hanekom, and M. Hatherill. 2013. "Knowledge and Acceptability of Patient-Specific Infection Control Measures for Pulmonary Tuberculosis." *American Journal of Infection Control* 41 (8): 717–22. <https://doi.org/10.1016/j.ajic.2012.10.003>.

- Kumar, A., D. Gupta, S. B. Nagaraja, S. A. Nair, S. Satyanarayana, R. Zachariah, and A. D. Harries. 2013. "Screening of Patients with Diabetes Mellitus for Tuberculosis in India." *Tropical Medicine and International Health* 18 (5): 646–54. <https://doi.org/10.1111/tmi.12083>.
- Lönnroth, K., K. G. Castro, J. M. Chakaya, L. S. Chauhan, K. Floyd, P. Glaziou, and M. C. Raviglione. 2010. "Tuberculosis Control and Elimination 2010–50: Cure, Care, and Social Development." *Lancet* 375 (9728): 1814–29. [https://doi.org/10.1016/S0140-6736\(10\)60483-7](https://doi.org/10.1016/S0140-6736(10)60483-7).
- Loveday, M., J. Smith, and C. Day. 2013. "Knowing our TB Epidemic: Key Challenges Facing the TB Programme in South Africa." *South African Health Review* 139–53.
- Mabunda, J., and H. A. Bradley. 2011. Factors Contributing to Poor Performance of Directly Observed Treatment Short-Course (DOTS) in Mopani District of Limpopo Province, South Africa. *African Journal for Physical, Health Education, Recreation and Dance* 2 (1): 93–107.
- Massyn, N., Peer, N., English, R., Padarath, A., Barron, P. and Day, C.E., 2016. District health barometer 2015/16. *Durban: Health Systems Trust*.
- Mohajan, H. 2014. "Tuberculosis is a Fatal Disease among Some Developing Countries of the World." *Munich Personal RePEc Archive* 3 (1): 18–31. <https://mpira.ub.uni-muenchen.de/82851/>.
- Nienhaus, A., A. Schablon, A. M. Preisser, F. C. Ringshausen, and R. Diel. 2014. "Tuberculosis in Healthcare Workers—A Narrative Review from a German Perspective." *Journal of Occupational Medicine and Toxicology* 9 (1): 9. <https://doi.org/10.1186/1745-6673-9-9>.
- Piatek, A. S., M. van Cleeff, H. Alexander, W. L. Coggin, M. Rehr, S. van Kampen, T. M. Shinnick, and Y. Mukadi. 2013. "GeneXpert for TB Diagnosis: Planned and Purposeful Implementation." *Global Health: Science and Practice* 1 (1): 18–23. <https://doi.org/10.9745/GHSP-D-12-00004>.
- Polit, D. F., and C. T. Beck. 2012. *Resource Manual for Nursing Research: Generating and Assessing Evidence for Nursing Practice*. 9th ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams and Wilkins.
- Republic of South Africa. 1997. *Compensation for Occupational Injuries and Diseases Amendment Act, 1997 (Act No. 61 of 1997)*. [www.labour.gov.za/1997-2](http://www.labour.gov.za/1997-2).
- SANAC (South African National AIDS Council). n.d a. South Africa's National Strategic Plan for HIV, TB and STIs 2012–2016. Accessed 24 February 2020. <https://sanac.org.za/wp-content/uploads/2015/11/4-National-Strategic-Plan-for-HIV-STIs-and-TB-2012-2016.pdf>.

- SANAC (South African National AIDS Council). n.d b. Let Our Actions Count: South Africa's National Strategic Plan for HIV, TB and STIs 2017–2022. Accessed 24 February 2020. [https://sanac.org.za/wp-content/uploads/2017/06/NSP\\_FullDocument\\_FINAL.pdf](https://sanac.org.za/wp-content/uploads/2017/06/NSP_FullDocument_FINAL.pdf).
- Sreeramareddy, C. T., Z. Z. Qin, S. Satyanarayana, R. Subbaraman, and M. Pai. 2014. "Delays in Diagnosis and Treatment of Pulmonary Tuberculosis in India: A Systematic Review." *International Journal of Tuberculosis and Lung Disease* 18 (3): 255–66. <https://doi.org/10.5588/ijtld.13.0585>.
- Streubert, H. J., and D. R. Carpenter. 2011. *Qualitative Research in Nursing: Advancing the Humanistic Imperative*. Philadelphia: Lippincott Williams and Wilkins.
- Tolossa, D., G. Medhin, and M. Legesse. 2014. "Community Knowledge, Attitude, and Practices towards Tuberculosis in Shinile Town, Somali Regional State, Eastern Ethiopia: A Cross-Sectional Study." *BMC Public Health* 14 (1): 804. <https://doi.org/10.1186/1471-2458-14-804>.
- Tudor, C., M. Mphahlele, M. van der Walt, and J. E. Farley. 2013. "Health Care Workers' Fears associated with Working in Multidrug- and/or Extensively-Resistant Tuberculosis Wards in South Africa." *International Journal of Tuberculosis and Lung Disease* 17 (10): 22–29. <https://doi.org/10.5588/ijtld.13.0109>.
- Tudor, C., M. L. van der Walt, B. Margot, S. E. Dorman, W. K. Pan, G. Yenokyan, and J. E. Farley. 2016. "Occupational Risk Factors for Tuberculosis among Healthcare Workers in KwaZulu-Natal, South Africa." *Clinical Infectious Diseases* 62 (suppl 3): S255–S261. <https://doi.org/10.1093/cid/ciw046>.
- Ukwaja, K. N., I. Alobu, and E. M. Onu. 2013. "Frontline Healthcare Workers' Knowledge of Tuberculosis in Rural South-East Nigeria." *African Journal of Respiratory Medicine* 9 (1).
- Verkuijl, S., and K. Middelkoop. 2016. "Protecting our Front-Liners: Occupational Tuberculosis Prevention through Infection Control Strategies." *Clinical Infectious Diseases* 62 (suppl 3): S231–S237. <https://doi.org/10.1093/cid/civ1184>.
- Von Delft, A., A. Dramowski, C. Khosa, K. Kotze, P. Lederer, T. Mosidi, J. A. Peters et al. 2015. "Why Healthcare Workers are Sick of TB." *International Journal of Infectious Diseases* 32:147–51. <https://doi.org/10.1016/j.ijid.2014.12.003>.
- WHO (World Health Organization). 2014. *Global Tuberculosis Report 2014*. Geneva: WHO.

WHO (World Health Organization). 2018. *Global Tuberculosis Report 2018*. Geneva: WHO.

Yuen, C. M., F. Amanullah, A. Dharmadhikari, E. A. Nardell, J. A. Seddon, I. Vasilyeva, Y. Zhao, S. Keshavjee, and M. C. Becerra. 2015. "Turning off the Tap: Stopping Tuberculosis Transmission through Active Case-Finding and Prompt Effective Treatment." *Lancet* 386 (10010): 2334-43. [https://doi.org/10.1016/S0140-6736\(15\)00322-0](https://doi.org/10.1016/S0140-6736(15)00322-0).

Zelnick, J. R., A. Gibbs, M. Loveday, N. Padayatchi, and M. R. O'Donnell. 2013. "Health-Care Workers' Perspectives on Workplace Safety, Infection Control, and Drug-Resistant Tuberculosis in a High-Burden HIV Setting." *Journal of Public Health Policy* 34 (3): 388-402. <https://doi.org/10.1057/jphp.2013.20>.