

https://dspace.org/

Mycobacterium tuberculosisspecific cytokine responses according to HIV status among household contacts of people with TB

C L Day; F Willis; B S Staitieh; A Campbell; Neil Martinson ...

https://hdl.handle.net/10539/39019
WOS

Downloaded from a DSpace repository. https://dspace.org/

This open-access article is distributed under Creative Commons licence CC-BY-NC 4.0.

Healthcare workers' knowledge and practice of the South African national tuberculosis management guidelines

K Motlhaoleng,[1,2] MPH; **L Moropeng,**[1] MSc (Med Virol); **P Abraham,**[2] HDM; **T Moloantoa,**[2] MB ChB

[1] *School of Health Systems and Public Health, Faculty of Health Sciences, University of Pretoria, South Africa*
[2] *Perinatal HIV Research Unit, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa*

Corresponding author: *L Moropeng (lucky.moropeng@up.ac.za)*

Background. Tuberculosis (TB) remains a global public health concern. The 2014 South African (SA) national TB management guidelines were developed to decrease the burden of TB, but implementation remains a challenge.
Objectives. To estimate healthcare workers' level of knowledge about the national TB management guidelines and to assess the implementation of these guidelines.
Methods. A cross-sectional descriptive study was conducted in four randomly selected health facilities in Dr Kenneth Kaunda district, North West Province, SA. We administered a TB knowledge questionnaire and reviewed TB registers and 204 patient files.
Results. A total of 38 participants completed the TB knowledge questionnaire. The majority were professional nurses (89%). The participants' mean (standard deviation) age was 46 (8) years, and the median (interquartile range) career length was 10 (8 - 17) years. Inadequate knowledge of the national TB management guidelines was revealed in 12 participants (32%). The review of the TB register showed that 163 153 patients were screened for TB. Of these, 9 308 (6%) had presumptive TB, 8 116 (87%) had an Xpert test and 1 292 (16%) had positive Xpert results. Overall, 1 150 (12%) of the patients with presumptive TB were diagnosed with drug-sensitive TB and started treatment based on laboratory results and a clinical diagnosis. Of this sample, 999 patients (87%) were treated successfully. The patient file review showed that a total of 197 patients (97%) received the correct treatment dose according to body weight and treatment phase. Smear microscopy was consistently done throughout the intensive and continuation phases of TB treatment. Body weight was monitored in 199 patients (98%). Contact investigation was conducted for 133 patients (65%), and there was evidence that child contacts aged <5 years were started on isoniazid preventive therapy. Only 110 patients (54%) had documented HIV status. Of these, 66 (60%) were HIV positive, and 39 (59%) of them received antiretroviral therapy. Body mass index was monitored in 55 patients (27%). Eighty (39%) of the patients with TB were women of childbearing potential, and only 8 (10%) of them had their pregnancy test results recorded. Treatment side-effects were reported in 17 patient files (8%); 13 (76%) were managed and 8 (62%) had resolved side-effects.
Conclusion. Most participants had adequate knowledge of the national TB management guidelines. A high TB treatment success rate was noted, along with some good practices. The study also highlights several knowledge and practice gaps that can be overcome by measures such as quality audits to improve record keeping. Adequate training of healthcare workers, sustaining and updating knowledge through continuous training, and strengthened supervision mechanisms to ensure compliance with the guidelines are recommended.

S Afr Med J 2023;113(5):e16658. https://doi.org/10.7196/SAMJ.2023.v113i5.16658

Tuberculosis (TB) is a global epidemic and remains one of the world's top infectious diseases, claiming the lives of ~4 000 persons every day.[1] About a quarter of the world's population is infected with *Mycobacterium tuberculosis*, the bacterium that causes TB.[1] The probability of developing active TB disease is increased among people living with HIV, and people exposed to risk factors such as poverty, diabetes, smoking, and excessive alcohol consumption.[2,3] People living with HIV (PLHIV) are 18 times more likely to develop active TB disease than people without HIV.[1,4] In 2019, 10 million people had active TB disease worldwide.[5] Of these, 5.6 million were men, 3.2 million were women, and 1.2 million were children.[5] Although TB is preventable and treatable, a total of 1.4 million people died from the disease in 2019, including 208 000 PLHIV.[1]

South Africa (SA) is one of the 30 countries with a high burden of TB, contributing 87% of estimated incident cases worldwide and, on its own, 3.6% of the global caseload.[1,6] SA has >7 million PLHIV with a 58% rate of TB/HIV co-infection, and is among the 14 countries with the highest burden of TB, TB/HIV and drug-resistant TB.[1,7] The incidence of TB in SA, based on 2019 case-finding data, was estimated at 615 per 100 000 population.[1] SA is among the 78 countries globally that achieved a 2020 milestone of a 20% decline in TB incidence.[1,6] The first-ever SA TB prevalence survey, conducted in 2018, found a point prevalence of 737 per 100 000 population and noted a disproportionately high burden in men compared with women.[1,8] There has been some global progress in preventing TB deaths, but substantial gaps in TB management remain.[1,9] The COVID-19 pandemic has eroded previous gains of the TB programme and has resulted in a significant decline in TB case notifications.[1]

TB care and management in SA are guided by the 2014 national TB management guidelines[10] and other relevant policies and standard operating procedures. The national TB management guidelines were developed to guide healthcare workers, prevent and treat TB, and restore the health of TB patients.[10] Healthcare workers are essential to implement these guidelines; however, their personal and cultural viewpoints can influence their practice.[11,12] Healthcare workers' knowledge and practice related to the guidelines can play a significant role in their ability to diagnose and care for individuals with TB.[13,14] There is limited research on healthcare workers' experience in the implementation of TB management guidelines.[9]

The objectives of the present study were to estimate healthcare workers' level of knowledge about the national TB management guidelines and to assess the implementation of these guidelines.

Methods

A cross-sectional descriptive study was conducted in randomly selected health facilities in Dr Kenneth Kaunda district, North West Province, SA. The district has limited resources and had a population of ~772 320 in 2019.[15] The incidence of TB in the district was 772 per 100 000 population in 2019, and the mortality rate for TB and HIV co-infection was 27%.[15]

For the primary aim of the study, we performed a purposive sampling of 38 TB healthcare workers from 16 health facilities in the Matlosana subdistrict and administered a TB knowledge questionnaire. We included healthcare workers who had experience working with TB patients for ≥1 year. Healthcare workers with <1 year of experience and non-clinical support staff were excluded from the study. The TB knowledge questionnaire was self-designed, using the national TB management guidelines as a yardstick. This knowledge questionnaire was developed in consultation with TB specialists from the district hospital to improve its content validity. We conducted a pilot study before implementing the primary research to assess the feasibility and acceptability of the data collection tools. The TB knowledge questionnaire comprised 23 critical multiple-choice questions about TB diagnosis, treatment and management according to the national guidelines. Answers were coded as correct if they aligned with the national guidelines. Each correct answer was scored as 1 and each incorrect answer as 0. The scores for all questions were totalled, and the mean was obtained from the sum. Participants who scored above the mean were considered to have adequate knowledge, and those with a score below the mean were considered to have inadequate knowledge.

For the secondary aim of the study, we conducted a review of TB registers at four randomly selected health facilities and supplemented this with a review of patient files from the same health facilities to assess the level of implementation of the national guidelines. There are four local areas in Matlosana subdistrict, and four health facilities (i.e. one clinic from each local area) were randomly selected. We randomly sampled 50 patient files in each facility and included all the TB registers from January 2016 to December 2017. We used data extraction sheets to collect data on TB detection, treatment initiation, baseline investigations and treatment outcome.

Data analysis was done using Stata 15 (StataCorp, USA). The analysis included descriptive statistics: frequencies, percentages, medians and interquartile ranges (IQRs) for categorical data. The mean, minimum, maximum, standard deviation (SD) and 95% confidence interval (CI) were used to explore the quantitative variables.

The study was approved by the University of Pretoria Faculty of Health Sciences Research Ethics Committee (ref. no. 314/2018), the University of the Witwatersrand Human Research Ethics Committee – Medical (ref. no. M180847), the North West Province Department of Health (ref. no. NW_201807_006), and Matlosana subdistrict management.

Results

We approached and recruited 133 healthcare workers from the selected study sites. Ninety-five were excluded from the study: 2 had worked with TB patients for less than a year, 2 did not work with TB patients, 19 were administrative staff who did not provide direct care to TB patients, and 72 were non-clinical support staff such as counsellors and community health workers who did not provide clinical management of TB patients.

The remaining 38 healthcare workers completed the TB knowledge questionnaire (Table 1). The sampled participants worked with TB patients in various health facilities or were part of ward-based outreach teams. Most of the participants were female (74%), the mean (SD) age was 46 (8) years, and the median (IQR) career length was 10 (8 - 17) years. The largest professional group (89%) was professional nurses. Only 29% (*n*=11) of the participants had received their highest education at university level, with most (71%; *n*=24) obtaining their highest education at a college.

The scores for the 23 questions were totalled, and a mean of 19.1 (95% CI 18.5 - 19.6) was obtained from the total sum of questions. Of the participants, 32% (*n*=12) scored below the mean and were considered to have inadequate knowledge of the national TB management guidelines (Table 2).

All the participants knew the definition of TB, while 80% (*n*=30) knew the correct treatment phases and the standard treatment regimen for drug-sensitive TB. Twenty-nine participants (76%) provided correct responses for TB contact tracing and preventive measures. However, 19 participants (50%) lacked knowledge about the laboratory investigations for drug-resistant TB, and almost half (47%; *n*=18) lacked knowledge about TB/HIV co-infection management. Similarly, 47% (*n*=18) provided incorrect responses with regard to patients' autonomy for being treated for TB.

The TB registers in the four study sites (January 2016 - December 2017) recorded 163 513 patients who were screened for TB. Of these, 9 308 (6%) had presumptive TB and 8 116 (87%) had an Xpert test. Of those tested, 1 292 (16%) had positive Xpert results. Overall, 1 150 (12%) of the presumptive TB patients were diagnosed with drug-sensitive TB and started on treatment based on laboratory results and the clinical diagnosis. Of the patients started on TB treatment, 999 (87%) were treated successfully.

A review of 204 patient files supplemented the review of the TB registers. This patient file review was done to identify practical implementation of the guidelines. In addition to the 87% TB treatment success rate, several good practices were identified. A total of 197 patients (97%) received the correct treatment dose according to body weight and treatment phase. Smear microscopy was consistently done throughout the intensive and continuation phases of TB treatment to monitor patients' progress. Body weight was monitored in 199 patients (98%). Contact investigation was conducted for 133 (65%) patients, and there was evidence that child contacts aged <5 years were started on isoniazid preventive therapy (IPT). Less favourable was the proportion of patients with documented HIV status (54%; *n*=110). Of these, 45 (40%) were HIV negative. Of the 66 (60%) who were HIV positive, 39 (59%) were receiving antiretroviral therapy (ART). Body mass index (BMI) was poorly monitored, with only 55 patients (27%) having a BMI recorded. While 80 (39%) of the patients with TB were women of childbearing potential, only 8 (10%) had a pregnancy test result recorded. Treatment side-effects were reported in 17 (8%) patient files; 13 (76%) were managed, and 8 (62%) had a record of resolved side-effects.

Discussion

Our study estimated the participants' level of knowledge about the national TB management guidelines and assessed the implementation of these guidelines. Most participants (68%) had adequate knowledge of the national guidelines. It is worth noting that the mean used as a minimum for 'adequacy' was relatively high at 19 since the maximum score was 23. Our findings are similar to those of studies conducted in Jamaica and Botswana, which reported that some healthcare workers lacked knowledge about the available guidelines and policies.[14,16] In our study, participants predominantly lacked knowledge about laboratory testing used to confirm drug-resistant TB, management of TB/HIV co-infection, and patients' autonomy in being treated for TB. These areas are critical components of TB diagnosis and management.[10]

While it is known that drug-resistant TB is an emerging public health concern, 50% of the participants lacked the necessary knowledge about laboratory testing used to confirm drug-resistant TB and appropriate laboratory tests to monitor the response to treatment. Healthcare workers need constant reminders that bacteriological confirmation is essential if drug resistance is suspected, in severe or complicated cases, or if the diagnosis is uncertain.[10] For early drug-resistant TB treatment, rapid drug susceptibility testing (DST) of isoniazid and rifampicin, such as Xpert and line probe assay, is preferred over conventional testing.[10,17] Additional advantages of rapid DST include reduced mortality, increased possibility of cure, decreased development of additional resistance, and reduced possibility of failure and relapse.[10,17] Conventional DST of cultured mycobacteria often takes 1 - 3 months to provide the results, which may lead to poor linkage to care while waiting for the results.[17] The use of sputum smear microscopy and culture rather than sputum smear microscopy alone is recommended for monitoring patients with drug-resistant TB during treatment.[17] Concomitant use of sputum smear microscopy and culture test results helps to identify patients who remain bacteriologically positive or revert to positive following initial conversion to negative.[17] Clinicians can use this information to identify patients in whom treatment is likely to fail and implement infection control measures as soon as possible.[17] The identified knowledge gap calls for ongoing training, education and mentoring of healthcare workers to comply with the prescripts of the guidelines.

The participants also lacked knowledge about the management of TB/HIV co-infection. An SA study reported similar findings after evaluating the key barriers and challenges in the healthcare system, with both general operational challenges and HIV programme-specific challenges identified.[18] Our study finding partially explains why TB/HIV co-infection control remains a major challenge in SA despite the availability of international and national guidelines for integrating TB and HIV services.[4] The integration of TB and HIV in primary healthcare services remains of critical importance given the overwhelming findings from many global studies.[11] TB is one of the leading infectious diseases that kill PLHIV, and HIV is the core driver of TB prevalence in key populations.[4] The national guidelines serve as an enabler for comprehensive management of TB/HIV co-infected patients.[10] These guidelines offer realistic guidance for implementation in practical settings.[19] However, the 2014 national TB management guidelines could be updated to align with current global recommendations.

Interestingly, most of the participants regarded TB treatment as involuntary. In contrast, the ethical principle of autonomy emphasises the patient's right to make informed decisions about their care and treatment.[20] Although TB is a notifiable infectious disease, treatment remains voluntary.[10] Overall, the three critical questions about laboratory testing used to confirm drug-resistant TB, management of TB/HIV co-infection, and patients' autonomy for being treated for TB highlight the urgent need to address these knowledge deficiencies in healthcare workers.

Infection control education is an important component of TB prevention and curbing the spread of TB.[10,21] The necessity for infection control education and counselling during contact tracing was overlooked by 24% of the participants. In order to dispel this misconception, infection control education is necessary in contact tracing, as household members of people with infectious TB are at high risk of becoming infected and developing the disease.[21] Infection control messages need to promote the importance of early case detection, adherence to treatment and implementation of proper TB infection control measures such as cough etiquette and respiratory hygiene in the household, before and after diagnosis of TB.[21,22]

Factors such as lack of training and development have been reported to compound inadequate knowledge of healthcare workers.[9] Various training platforms and mechanisms can enhance the knowledge and skills of healthcare workers in assessing, diagnosing and treating patients with TB.[23] Healthcare workers can develop competency skills to enrich their confidence and capability to implement the national guidelines and advance the quality of healthcare.[10,14] The ability of health service managers to provide on-the-job training to their staff is considered a significant determinant in boosting performance and curbing the gaps in the diagnosis and management of TB.[22,24]

We recognised that knowledge does not necessarily translate into practice. We therefore conducted a review of TB registers and patient files to evaluate how the knowledge and practice of healthcare workers has affected the implementation of the national guidelines. The review revealed gaps in the TB treatment cascade from diagnosis to treatment initiation and completion. From the number of patients with presumptive TB, we expected to see an increase in the number of patients diagnosed with drug-sensitive TB and started on treatment based on laboratory results and clinical diagnoses. However, the study shows that a small proportion (12%) of patients were diagnosed with TB and started on treatment. These findings confirm that under-diagnosis and under-reporting of TB patients are serious obstacles to the successful implementation of the TB management guidelines and policies.[1] Although these gaps were noted, the 87% treatment success rate in the four study sites is commendable.

We supplemented the TB register review with a review of 204 patient files to analyse granular patient-level data and to assess the

Table 1. Descriptive statistics of demographic variables

Measure	Total (*N*=38), *n* (%)	Female (*n*=28), *n* (%)	Male (*n*=10), *n* (%)
Profession			
Professional nurse	34 (89)	24 (71)	10 (29)
Enrolled nurse	4 (11)	4 (100)	0
Highest education level			
College	27 (71)	18 (67)	9 (33)
University	11 (29)	10 (91)	1 (9)

Table 2. Professional profile of study participants with inadequate knowledge (less than the mean of 19) of the national tuberculosis management guidelines

Profession	Total (*N*=12), *n* (%)	Female (*n*=5), *n* (%)	Male (*n*=7), *n* (%)
Professional nurse	11 (92)	4 (36)	7 (64)
Enrolled nurse	1 (8)	1 (100)	0

current practice. In terms of good practices, the majority (97%) of TB patients received the correct treatment dose according to the patient's body weight and treatment phase. Microbiological sputum testing was done consistently throughout the intensive and continuation phases of TB treatment. Body weight is a useful indicator for clinical improvement, and was recorded in 98% of the files. The urgency of contact investigation depends on the degree of infectiousness of the index TB patient, whether they have drug-sensitive or drug-resistant TB, and the immunity of contacts.[10] Contact investigation was recorded in 65% of patients diagnosed with TB, and there was evidence that child contacts aged <5 years were started on IPT. We recognised these good practices as essential factors that foster the implementation of the national guidelines.

Our study revealed inconsistent practice in baseline evaluations for patients started on TB treatment across different health facilities. All patients with confirmed TB must be offered HIV counselling and testing.[10] However, only 54% of the 204 TB patients had recorded HIV status. In addition to HIV testing, co-infected TB patients require ART regardless of CD4 count, and such patients should be prioritised for ART initiation.[10] However, in our study, only ~60% of co-infected patients received ART. This practice gap can be linked to the knowledge gap, as 53% of participants considered that co-infection with HIV does not always mean starting ART, regardless of CD4 count. The knowledge and practice gaps reinforce the notion that managing TB/HIV-co-infected patients is challenging.[11,18] Healthcare workers should be trained thoroughly on integrated management of TB/HIV to improve clinical practice.[11]

Only 55 of the patients (27%) had their BMI recorded, indicating that BMI was poorly managed. An SA study found that obese and overweight people have a substantially decreased mortality risk and TB risk.[25] In contrast, those who are underweight according to their BMI have an increased risk of mortality.[25] BMI monitoring should form the basis for managing patients with TB, given the high TB/HIV co-infection rate in SA and the evidence that low BMI is a strong independent predictor of mortality.[26] Blood glucose testing was recorded in approximately a third of the files, which is problematic because the relative risk of death among TB patients with diabetes is high compared with that in TB patients who do not have diabetes.[10] Only 10% of females of childbearing potential had a pregnancy test result recorded, which is not in line with the national TB guidelines. This shortfall is a concern because the prevalence of TB in pregnancy has greatly increased and TB ranks third as a cause of overall maternal mortality.[10]

It was also concerning to note minimal recording of treatment side-effects. Several studies in SA have found that TB clinical files are often incorrectly and incompletely recorded.[27] Poor recording of clinical records has a negative impact on patient care because the management of patients is entirely dependent on the histories recorded in their clinical files.[28] In addition to the poor recording revealed in our study, there were gaps in the management of side-effects, with only 76% of patients with side-effects being managed. Treatment side-effects are associated with non-adherence and defaulting.[27] To reduce the negative impact of side-effects on TB treatment adherence, it is critical that healthcare workers are adequately trained in their recognition and management.[27] Such training should include providing concise pretreatment counselling to patients on possible side-effects of treatment and proper recording in clinical records to improve the completeness of reporting.[27,29] Regular peer or manager audits of clinical records should be undertaken to validate the correlation between data sources, enhance data quality, and ultimately improve management of side-effects.[29]

A functional healthcare system is necessary to ensure that all patients with confirmed TB are started on TB treatment and managed adequately for optimal outcomes.[10] The results of our study therefore cannot be viewed in isolation from the challenges of the broader healthcare system. These include a longstanding shortage of healthcare workers and a skills imbalance.[20] Our study revealed compelling knowledge deficits and practice gaps, which call for strengthened remedial actions for improved quality of TB management. Policies and treatment guidelines are essential for healthcare workers' practice in providing equitable health services.[20] There is a need for solid stewardship and leadership to improve health system performance.[30] Health service managers are key drivers of the health system performance and should strengthen supervision mechanisms and ensure compliance with the guidelines.[31]

There are some important limitations to consider when interpreting the results of this study. First, we had a small sample size. We approached and recruited 133 healthcare workers, but 95 were excluded from the study because they did not meet the eligibility criteria for healthcare workers providing clinical management of TB patients. Second, the mean used as a minimum for 'adequacy' on the TB knowledge questionnaire was relatively high at 19, since the maximum score was 23. Lastly, there was evidence that child contacts aged <5 years were started on IPT; however, owing to the inconsistent documentation of child contact investigations, we could not determine the number of child contacts eligible for IPT among those who were started on it.

Conclusion

Most participants had adequate knowledge of the national TB management guidelines, and while this knowledge may be translated into practice, this was not necessarily reflected in the clinical records. The study has highlighted some practice gaps that could be overcome by measures such as quality audits to improve record keeping and some knowledge gaps that could be addressed with training. Further research could repeat this study over a wider geographical area.

Declaration. The research for this study was done in partial fulfilment of the requirements for KM's MPH degree at the University of Pretoria.

Acknowledgements. The authors acknowledge the Matlosana subdistrict department of health clinic staff and facility managers for their relentless efforts to improve TB management.

Author contributions. KM was involved in conception and design of the study, acquisition, analysis and interpretation of data, drafting of the article, and final approval of the version to be submitted. PA analysed and interpreted the data, revised the article and gave final approval of the version to be submitted. TM interpreted the data, revised the article critically for important intellectual content, and gave final approval of the version to be submitted. LM was involved in the supervision, conception and design of the study and interpreted the data, revised the article critically for important intellectual content, and gave final approval of the version to be submitted.

Funding. The study was funded by the Stellenbosch University Collaborative Capacity Enhancement through Engagement with Districts (SUCCEED) grant, supported by the President's Emergency Plan for AIDS Relief (PEPFAR) through the Centers for Disease Control and Prevention under the terms of GH001536.

Conflicts of interest. None.

1. World Health Organization. Global tuberculosis report 2020. Geneva: WHO, 2020. https://www.who.int/publications/i/item/9789240013131 (accessed 22 July 2022).
2. Bonita R, Beaglehole R, Kjellström T; World Health Organization. Basic Epidemiology. 2nd ed. Geneva: WHO, 2006. https://apps.who.int/iris/bitstream/handle/10665/43541/9241547073_jpn.pdf;sequence=3 (accessed 25 August 2022).
3. Diedrich C, O'Hern J, Wilkinson R. HIV-1 and the *Mycobacterium tuberculosis* granuloma: A systematic review and meta-analysis. Tuberculosis 2016;98:62-76. https://doi.org/10.1016/j.tube.2016.02.010
4. Kana B, Churchyard G. Tuberculosis: The global killer. S Afr J Sci 2013;109(9/10):2. https://doi.org/10.1590/sajs.2013/a0036
5. World Health Organization. Tuberculosis: Key facts. 14 October 2020. https://www.who.int/news-room/fact-sheets/detail/tuberculosis (accessed 12 July 2022).
6. Pillay Y, Mvusi L, Mametja L, Dlamini S. What did we learn from South Africa's first-ever tuberculosis prevalence survey? S Afr Med J 2021;111(5):402-404. https://doi.org/10.7196/SAMJ.2021.v111i5.15662
7. Pillay Y, Johnson L. World AIDS Day 2020: Reflections on global and South African progress and continuing challenges. South Afr J HIV Med 2021;22(1):1205. https://doi.org/10.4102/sajhivmed.v22i1.1205
8. Van der Walt M, Moyo S. The First National TB Prevalence Survey, South Africa 2018: Short report. 2021. https://www.knowledgehub.org.za/elibrary/first-national-tb-prevalence-survey-south-africa-2018 (accessed 10 June 2022).
9. Dlwati LV, Mavundla TR, Mbengo F. Facilitators for and barriers to the implementation of national tuberculosis management guidelines. Afr J Nurs Midwifery 2017;19(3):1-20. https://doi.org/10.25159/2520-5293/2862
10. National Department of Health, South Africa. National tuberculosis management guidelines 2014. Pretoria: NDoH, 2014. https://knowledgehub.health.gov.za/elibrary/national-tuberculosis-management-guidelines (accessed 5 May 2022).
11. Phetlhu DR, Watson MJ. Perceptions and attitudes of health workers towards patients co-infected with HIV and tuberculosis. J Soc Sci 2011;29(1):23-27.
12. Miller JA. The perceptions and beliefs of healthcare workers about clients with tuberculosis. MPH dissertation. University of Auckland, 2007. https://www.yumpu.com/en/document/view/30982285/the-perceptions-and-beliefs-of-healthcare-workers-about-clients-with- (accessed 25 August 2022).
13. Dimitrova B, Balabanova D, Atun R, Drobniewski F, Levicheva V, Coker R. Health service providers' perceptions of barriers to tuberculosis care in Russia. Health Policy Plan 2006;21(4):265-274. https://doi.org/10.1093/heapol/czl014
14. Tlale LB, Frasso R, Kgosiesele O, et al. Factors influencing health care workers' implementation of tuberculosis contact tracing in Kweneng, Botswana. Pan Afr Med J 2016;24:229. https://doi.org/10.11604/pamj.2016.24.229.7004
15. Massyn N, Day C, Ndlovu N, Padayachee T. District health barometer 2019/2020. Durban: Health Systems Trust, 2020. https://www.hst.org.za/publications/Pages/DHB2019-20.aspx (accessed 15 May 2022).
16. White ZN. Survey on the knowledge, attitudes and practices on tuberculosis (TB) among health care workers in Kingston and St Andrew, Jamaica. Master's dissertation. University of Liverpool, 2011.
17. World Health Organization. Guidelines for the programmatic management of drug-resistant tuberculosis – 2011 update. 15 February 2011. https://www.who.int/publications/i/item/9789241501583 (accessed 17 August 2022).
18. Naidoo N, Railton J, Jobson G, et al. Making ward-based outreach teams an effective component of human immunodeficiency virus programmes in South Africa. South Afr J HIV Med 2018;19(1):778. https://doi.org/10.4102/sajhivmed.v19i1.778
19. World Health Organization, Stop TB Initiative. Treatment of tuberculosis: Guidelines, 4th edition. 2010. https://apps.who.int/iris/handle/10665/44165 (accessed 22 August 2022).
20. Amref Health Africa. Training manual in leadership management & governance for health system strengthening in Africa. Nairobi, Kenya: Amref Health Africa, 2017. https://afrophc.org/wp-content/uploads/2022/06/eLMG-HSS-Manual-Volume-1-Lite.pdf (accessed 11 June 2022).
21. World Health Organization. WHO policy on TB infection control in health-care facilities, congregate settings and households. 15 February 2009. https://www.who.int/publications/i/item/9789241598323 (accessed 9 July 2022).
22. Sissolak D, Marais F, Mehtar S. TB infection prevention and control experiences of South African nurses – a phenomenological study. BMC Public Health 2011;11:262. https://doi.org/10.1186/1471-2458-11-262
23. Bozzani FM, Mudzengi D, Sumner T, et al. Empirical estimation of resource constraints for use in model-based economic evaluation: An example of TB services in South Africa. Cost Eff Resour Alloc 2018;16:27. https://doi.org/10.1186/s12962-018-0113-z
24. Bossert T, Bärnighaussen T, Bowser D, Mitchell A, Gedick G. Assessing financing, education, management and policy context for strategic planning of human resourses for health. Geneva: World Health Organization, 2007. https://apps.who.int/iris/handle/10665/43780 (accessed 14 August 2022).
25. Hanrahan CF, Golub JE, Mohapi L, et al. Body mass index and risk of tuberculosis and death. AIDS 2010;24(10):1501-1508. https://doi.org/10.1097/QAD.0b013e32833a2a4a
26. Van der Sande MA, van der Loeff MFS, Aveika AA, et al. Body mass index at the time of HIV diagnosis: A strong and independent predictor of survival. J Acquir Immune Defic Syndr 2004;37(2):1288-1294. https://doi.org/10.1097/01.qai.0000122708.59121.03
27. Awofeso N. Anti-tuberculosis medication side-effects constitute major factor for poor adherence to tuberculosis treatment. Bull World Health Organ 2008;86(3):B-D. https://doi.org/10.2471/BLT.07.043802
28. Luthuli LP. Medical records management practices in public and private hospitals in Umhlathuze area, South Africa. Master's (Information Science) dissertation. University of Zululand, 2017. http://hdl.handle.net/10530/1625 (accessed 15 May 2022).
29. Mngomezulu N, Cameron D, Olorunju S, Luthuli T, Dunbar R, Naidoo P. Reasons for the low bacteriological coverage of tuberculosis reported in Mpumalanga Province, South Africa. Public Health Action 2015;5(2):122-126. https://doi.org/10.5588/pha.15.0003
30. Armstrong SJ, Rispel LC. Social accountability and nursing education in South Africa. Glob Health Action 2015;8(1):27879. https://doi.org/10.3402/gha.v8.27879
31. Gilson L, Daire J. Leadership and governance within the South African health system. In: Padarath A, English E, eds. South African Health Review 2011. Durban: Health Systems Trust, 2011:69-80. https://researchonline.lshtm.ac.uk/id/eprint/1082607 (accessed 10 June 2022).

Accepted 22 March 2023.