Knowledge and practices regarding tuberculosis infection control among nurses in Ibadan, South-West Nigeria: a cross-sectional study

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Research article

Keywords: tuberculosis, infection, control, knowledge, practice, nurses

Posted Date: September 17th, 2019

DOI: https://doi.org/10.21203/rs.2.14583/v1

Version of Record: A version of this preprint was published at BMC Health Services Research on April 6th, 2020. See the published version at https://doi.org/10.1186/s12913-020-05156-y.

Abstract

Background: Nurses are particularly vulnerable to nosocomial tuberculosis (TB) infection because, being in the frontline of patient care, they are frequently exposed to patients with infectious TB disease. Although cost-effective measures are available for TB infection control (TBIC), they are often poorly implemented. Knowledge of TBIC is known to positively influence the practice of the measures. There is however limited data on the knowledge and practice of TBIC among nurses in Nigeria. This study was aimed at determining the levels of TBIC-related knowledge and practices of nurses in Ibadan, and associated socio-demographic factors.

Methods: This cross-sectional study utilized a self-administered questionnaire to collect data from 200 nurses in two secondary health facilities, in May 2014. STATA version 13 was used to analyze data: mean knowledge and practice scores of the nurses and logistic regression to explore their association with socio-demographic factors.

Results: The respondents had mean knowledge and practice scores of 68.2% and 79.9% respectively. Using cut-off points of 80% and 100% for good knowledge and practice scores respectively, small proportions of the nurses had good scores- knowledge (10.5%) and practice (6%). Knowledge was found not to be significantly associated with the socio-demographic factors. Work experience was the only factor that was significantly associated with practice, with the less experienced nurses (=<18 years of experience) having greater odds of obtaining good practice scores than the more experienced ones (OR 4.0, 95%CI 0.06-0.94). Also, there was no significant association between knowledge and practice scores. No structured TBIC training had been conducted at this time.

Conclusions: The study revealed that small proportions of the nurses had good knowledge and practice scores. The findings from this study will be useful for the planning of interventions to improve TBIC among nurses and other healthcare workers, and to benchmark monitoring and evaluation of the interventions. It is recommended that the nurses should be trained on TBIC to equip them with necessary knowledge and skills. This, together with appropriate TBIC policy directives, availability of TBIC equipment/supplies and facility architectural remodeling will contribute to optimal implementation of TB preventive measures.

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Background

Tuberculosis (TB) is a major global public health problem. It is caused by a microorganism called *Mycobacterium tuberculosis* (MTB) and commonly affects the lungs (pulmonary TB or PTB). PTB constitutes about 85% of all TB cases [1]. TB can also affect other organs in the body (extrapulmonary TB): the lymph nodes, abdomen, bones and joints, pericardium, pleura, genitourinary system and meninges; and can be generalized. PTB is the most important source of TB transmission as MTB is carried in air-borne droplets or aerosols

produced when a person infected with PTB coughs, sneezes, spits, talks or sings. TB is preventable and there is affordable and effective treatment for it. In 2017, an estimated 10 million new cases of TB were recorded globally, with the African region accounting for 25% of these cases; and worldwide, TB was the leading cause of death due to an infectious disease[2].

Nigeria is the most populous country in Africa, with a 2017 estimated population of about 182 million people [2]. It ranks sixth among the countries with the highest TB burden in the world and is included in three World Health Organization (WHO) lists of 30 high burden countries for TB, TB/HIV and MDR-TB for the period 2015-2020, as well as being one of the ten countries accounting for 80% of the global TB case finding gap. The country reported 418,000 incident TB cases in 2017, with an incidence rate of 219/100,000 [2]. TB was successfully treated in 86% of all cases registered in 2016. Approximately 155,000 people died from TB in the country in 2017, and about 23% of these deaths (35,000) occurred in TB/HIV co-infected people. It has an MDR-TB/RR-TB prevalence of 4.3% and 25% among new cases and previously treated cases respectively [2]. With an estimated national HIV prevalence of 3.0% among adults aged 15-49 years and 3.2 million people living with HIV (PLHIV), it has the second largest HIV burden in the world [3,4].

The transmission of TB in health facilities, known as nosocomial TB transmission, poses a particular challenge for healthcare workers (HCWs) worldwide. The increased risk of nosocomial TB transmission among HCWs has been well-documented and the incidence of TB disease in HCWs are generally higher than in the general population [5-8]. This risk is worsened by the increased exposure of HCWs to infectious TB patients, especially when there is inadequate implementation of TBIC measures [9-11]. Effective TBIC requires strict adherence to recommended control measures. Because of the diversity of the risk factors for the transmission of TB in health facilities, WHO has advocated for the adoption of several TB infection control measures [12]. These include: (i) Managerial measures, which are concerned with the establishment of a facility infection control committee, assessment of the risk of TB transmission in the facility and the development of infection control policies and plan (ii) Administrative measures, which are considered the first priority even

in resource-limited settings as they have the greatest impact on preventing nosocomial TB transmission; these ensure prompt identification of coughing patients at triage, their movement to a separate area in the clinic, promotion of cough etiquette and fast-tracking coughing patients for prompt diagnosis and treatment (iii) Environmental control measures, which are aimed at reducing the number of infectious droplet nuclei in the environment by maximizing natural ventilation (keeping windows and doors open); the use of fans, complex and expensive mechanical ventilation (negative pressure); as well as ultraviolet germicidal irradiation (UVGI) to kill MTB organisms; and (iv) Personal protection equipment (PPE) e.g. particulate respirator; because it is expensive and specialized skill is required for its use, it is usually limited to high-risk areas such as MDR-TB treatment centre and bronchoscopy suite. Since it is not feasible to implement expensive technologies such as mechanical ventilation, isolation rooms, ultraviolet gamma irradiation (UVGI) and respirators in most low- and medium-income countries (LMIC), it has been recommended that simple, practical and cost-effective interventions be adopted to reduce the exposure of HCWs to infectious TB patients in these settings [13]. These measures have been successfully implemented in most high-income countries and in some resource-limited settings [14]. Poor implementation of the recommended control measures by HCWs has however been reported [15-17]. The adoption and implementation of TBIC practices by HCWs are known to be positively influenced by good knowledge regarding occupational TB exposure [18,19]. HCWs have been shown to have varying levels of knowledge and practice concerning TBIC and a good understanding of TBIC does not necessarily translate into adequate TBIC practices [11,20]. In addition to poor knowledge, weak managerial support, poor funding, lack of space and inadequate staffing have been identified as barriers to implementation of TBIC [21].

Surveys have been conducted in Nigeria to assess the level of implementation of TBIC practices in health facilities, which has been found to be generally poor, and despite the availability of national guidelines for the implementation of TBIC, administrative measures are yet to be put in place in most facilities providing care for TB patients [16,20,25]. Nursing staff are at high risk of acquiring TB because they are in the frontline of patient care and are frequently exposed to patients with infectious TB disease [22,23]. They also play a critical role in curbing the spread of TB in health facilities. There is however paucity of data on the knowledge and practice of TBIC among nurses in Nigeria. Available studies that addressed individual HCWs are either focused on personnel in specific units in health facilities such as DOTS workers or diffusely include general HCWs [24-25]. The results from these studies show gaps in

TBIC-related knowledge, especially regarding TBIC, and the actual practice of the measures among HCWs. Further studies that specifically target nurses are needed since they usually have the earliest contact with infectious TB cases in the facilities and can therefore play a crucial role in controlling the spread of TB.

Previous studies have also explored the influence of HCWs' socio-demographic characteristics on their knowledge and practices concerning TBIC. Researchers in Addis Ababa, Ethiopia, found TBIC knowledge to be significantly associated with work experience, while age and marital status were not [26]. Other studies in Northwest Ethiopia and Uganda did not show any significant association between TBIC knowledge and age or work experience [27,28]. Furthermore, TBIC practice was not observed to be associated with age, work experience and marital status of the HCWs by some investigators [11,26,29]. Furthermore, TBIC practice was reported to be significantly related to its knowledge in studies in South Africa and Ethiopia [17,27].

This study was aimed at determining the levels of TBIC-related knowledge and practice of nurses in Ibadan, South-West Nigeria, and associated socio-demographic factors. The outcome of this study will contribute to the general body of knowledge on the status of implementation TBIC and will provide useful baseline information for the designing of appropriate interventions to address TBIC issues and for subsequent evaluation of interventions conducted.

Methods

Study design and setting

The study was a cross-sectional survey conducted in Ibadan, Oyo State, located in South-West Nigeria. With an estimated 2011 population of about 3,034,206 (density of 985/km^2), Ibadan is the third largest metropolitan area in Nigeria, and the largest by geographical area (3,080 km^2) [30,31]. Oyo State has the third highest TB burden in Nigeria, with 6901 cases reported in 2017 [32]. The study locations are in 2 local government areas (LGAs), Ibadan North and Ibadan South-West, with populations of 392,862 and 335,557 respectively.

Study population and sample

The study population consisted of nurses who work at two secondary health facilities, Ring Road State Hospital (Ibadan South-West LGA) and Adeoyo Maternity Teaching Hospital (Ibadan North LGA) that were purposively selected. Ibadan North has one tertiary health facility, one public secondary and 11 primary health centres (PHCs) while there are 3 public secondary facilities and 26 PHCs in Ibadan South-West. Based on available administrative data at the study sites, 390 nurses made up the study population. Yamane's approach was used to determine the sample size: $n=N/(1 + Ne^2)$, where N is the population size and e is the margin of error (taken as 5%) [33]. A sample size of at least 198 nurses was determined. To make provision for non-response, this was increased by 10% to 218.

Study Instrument

The self-administered questionnaire used for this study had a section on socio-demographics, as well as scales on the TBIC-related knowledge and practices of the nurses. These scales were adapted from an instrument used by Kanjee et al. [15] to study TBIC in a high drug-resistance setting in South Africa. The knowledge scale contained 33 items, with each having response options of "true", "false", or "I don't know". Each correct answer had a score of "1" and an incorrect answer, "0" while "I don't know" was considered an incorrect answer. The knowledge and practice scales had a maximum possible scores of 33. The TBIC practice scale had 6 items which measured self-reported frequency of adherence to various TBIC practices. It was scored using a 5-point Likert-type scale: "never" (1 point), "rarely" (2), "sometimes" (3), "often" (4), and "always" (5), giving it a maximum possible score of 30.

Data collection

Two research assistants and a supervisor were recruited and trained for the study. The nurses were informed about the study through their administrative structure. After explaining the purpose of the study to the participants, each of them that consented to take part in the study received a copy of the information leaflet, consent form and study questionnaire. After signing the consent, self-administered

questionnaire was issued out to each participant and returned after completion. The study was conducted in May 2014.

Statistical Analysis

STATA version 13 was used to conduct data analysis. Descriptive statistics were used to depict the socio-demographic characteristics of the nurses and their levels of TBIC-related knowledge and practices: means for continuous variables and frequency for categorical data. The knowledge and practice scales had maximum possible scores of 33 and 30 respectively. The knowledge score of each nurses was presented as a percentage of the maximum possible knowledge score i.e. score obtained/33 x 100%. Similarly, the practice score was presented as a percentage of the maximum possible practice score: score obtained/30 x 100%. In addition to giving the scores as mean percentages, they were further categorized into good and poor scores. Scores of 80% and above on the knowledge scale were regarded as good scores while those below 80% were taken as poor scores. With regard to the practice scale, score of 100% were taken as good scores while those less than this value were poor scores. The cut-off point for good practice score was set at 100% because optimal performance of TBIC measures is essential to minimize the nurses' risk of contracting TB. Binomial logistic regression analysis was used to examine associations with socio-demographic factors of the nurses as independent variables, and their TBIC knowledge and practices as separate dependent variables (both having dichotomized outcomes of "good" and "poor"). For the analysis with practice as the dependent variable, knowledge was also used as an independent variable. The socio-demographic factors examined were categorized as follows: age (44 years or less, and above 44 years), work experience (18 years or less, and above 18 years), sex, professional rank (junior and senior categories), and marital status (married and unmarried). The level of statistical significance was set at $p<0.05$.

Ethics considerations

The study was approved by Sefako Makgatho Health Sciences University Research Ethics Committee (MREC/H/271/2013: PG) and Oyo State Ministry of Health Research Ethical Review Committee in Nigeria (AD 13/479/557). Permission was obtained from Oyo State Hospitals Management Board and the management of Adeoyo Maternity Teaching Hospital and Ring Road State Hospital, both in Ibadan, Oyo State, Nigeria. Participation in the study was completely voluntary and measures were taken to ensure privacy and confidentiality of the participants, and written informed consent was obtained from each participant.

Results

200 out of the 218 questionnaires distributed were completed and returned by the respondents (response rate= 92%).

Socio-demographic characteristics of respondents

Table 1: Socio-demographic characteristics of respondents (N=200)

Variable	Mean (SD), years	n (%)
Age	43.7 (8.98)	
Work Experience	19.3 (9.72)	
Sex		
Female		184 (97.0)
Male		6 (3.0)
Age category		
=<44 years		102 (51.0)
>44 years		98 (49.0)
Work experience category		
=<18 years		101 (50.5)
>18 years		99 (49.5)
Professional rank		
Junior category		82 (41.0)
Senior category		118 (59.0)
Marital status		
Married		183 (91.5)
Unmarried		17 (8.5)

The mean age of the nurses was 43.7 years, as shown in Table 1. They also had a mean work experience of 19.3 years. The vast majority of them were females (97.0%). Age and work experience were also categorized into dichotomous groups. Using the median age of 44 years as cut-off point, 51.0% of the nurses were aged 44 years or less while 49% were older. With the median work experience of 18 years, they were almost equally matched by years of work experience (50.5% and 49.5% for =<18 years and >18 years respectively). The nurses were majorly females (97.0%). Also, most of them (59.0%) were in the senior professional rank (Principal Nursing Officers, Assistant Chief Nursing Officers and Chief Nursing Officers) as opposed to the junior rank (Nursing Officers and Senior Nursing Officers) who made up 41.0%. An overwhelming majority of the nurses (91.5%) were married.

TBIC knowledge and practices of respondents

(Please insert Table 2 here)

Table 2 shows the distribution of the nurses that had correct responses to the items on the knowledge scale. The scale had 3 domains: TB symptoms, mode of spread and risk of TB, and TBIC measures. On the 10 items related to TB symptoms, more than 80% of the nurses provided correct answers for the 5 common symptoms: cough of more than 2-3 weeks duration was correctly identified by nearly all of them (99.5%), followed by coughing up blood- 98.5%, weight loss- 97.5%, night sweats- 95.5%, and fever- 88%. Symptoms that are not related to TB were answered correctly by fewer nurses. For example, only 45% of them correctly noted that watery eyes are not a symptom of TB. Five (5) of the 13 items in the domain on the "mode of spread and risk of TB and risk of TB" were correctly answered by 80% of the nurses. The remaining 8 items had lower proportions with correct responses, the lowest being "Healthcare workers in the outpatients clinic have the same risk of getting TB as any other person" (7.5%). The items in this domain related to the risk of contracting TB generally had more incorrect responses, apart from "Patients with TB disease are more likely to infect others if they cough up a lot of sputum", which had 91% of the nurses giving the correct answer. On the HIV-related items, 67.0% of the participants responded correctly to whether it is alright for HIV-positive staff who are healthy to work in TB high-risk areas of the hospital. The other 2 items on the increased risk for HIV-positive persons had poor responses (23% and 21.5% respectively). The 10 items that dealt with TBIC measures had only 3 of them that each had over 80% of the nurses providing correct responses. These include 2 items that have to have to do with cough hygiene for coughing patients and keeping windows open in a room that has a coughing patient in it.

Table 3: Practice of TBIC measures by respondents (N = 200)

actice item	Never (1) n (%)	Rarely (2) n (%)	Sometimes (3) n (%)	Often (4) n (%)	Always (5) n (%)
ow frequently do you ask each patient when they enter the clinic if they are ughing?	11 (5.5)	23 (11.5)	30 (15.0)	56 (28.0)	80 (40.0)
ow frequently do you move coughing patients to wait at a nearby but separate waiting ea?	15 (7.5)	43 (21.5)	52 (26.0)	37 (18.5)	53 (26.5)
ow frequently do you instruct coughing patients to cover their mouth with tissues, ndkerchiefs or their arm when coughing?	3 (1.5)	2 (1.0)	15 (7.5)	31 (15.5)	149 (74.5)
ow frequently do you ensure collection of sputum samples from a patient is done tdoors or in separate, well-ventilated areas?	9 (4.5)	26 (13.0)	46 (23.0)	44 (22.0)	75 (37.5)
ow frequently do you rapidly move coughing patient to the front of the queue he/she is seen quickly to minimize the amount of time they spend in the clinic?	7 (3.5)	26 (13.0)	39 (19.5)	51 (25.5)	77 (38.5)
ow frequently do you open windows in patient waiting area or a room where coughing tients are attended to (or check to see if they are open already)?	3 (1.5)	9 (4.5)	12 (6.0)	23 (11.5)	153 (76.5)

With regards to the frequencies with which the nurses practised specific TBIC measures, Table 3 shows that less than 80% of the nurses answered “always” to the any of practice items. Opening of windows in the patient waiting area or room was the most frequent measure practised always (76.5%), followed by instructing coughing patients on cough etiquette (74.5%). These two most frequently practiced items also had the least proportions (1.5% each) that said they had never practiced the measures. Separation of coughing patients to a different waiting area had the least proportion of nurses that practised this always

(26.5%). This item also had the highest proportion of those that had never moved coughing patients to a separate waiting area (7.5%), followed by those that had never enquired if patients had cough as they entered the clinic (5.5%).

Table 4: TBIC knowledge and practice scores of participants (N=200)

	Mean (SD), %	n (%)
Score		
Knowledge	68.2 (10.4)	
Practice	79.9 (15.3)	
Score category		
Knowledge		
Good		21 (10.5)
Poor		179 (89.5)
Practice		
Good		12 (6.0)
Poor		188 (94.0)

Overall, the nurses had mean scores of 68.2% and 79.9% on the knowledge and practice scales respectively, as depicted in Table 4. Using the cut-off score of 80% to categorize the

knowledge scores, the majority of the nurses (89.5%) had poor knowledge scores (good knowledge score- 10.5%). Likewise, the majority of them (94.0%) had poor practice scores based on the cut-off of 100% for good practice score (good practice score- 6.0%).

Factors associated with the TBIC-related knowledge and practices of the respondents

Table 5: Association of sociodemographic characteristics of the respondents with their TBIC knowledge and practices (N=200)

	Knowledge			Practice		
osure variable	OR	*p*-value	95% CI	OR	*p*-value	95% CI
(Female)	1.74	0.62	0.19-15.6	3.33	0.29	0.36-31.0
(=<44 years)	0.79	0.62	0.32-1.98	0.34	0.11	0.09-1.30
erience category (=<18 years)	1.08	0.87	0.43-2.69	0.25	0.04*	0.06-0.94
essional rank (Senior)	1.35	0.52	0.55-3.35	0.46	0.26	0.12-1.75
ital status (Married)	1.15	0.86	0.24-5.42	0.98	0.98	0.12-8.06
wledge (Poor)				0.48**	0.51**	0.00-3.12**

*Significant; **Exact logistic regression

Logistic regression was used to determine the relationship between the socio-demographic dichotomous categories and TBIC knowledge and practice scores separately, as well as

between their knowledge scores and practice scores. All odd ratios less than 1.0 were converted to their inverse (1/OR) and interpreted in the light of “greater odds” [34]. As shown in Table 5, in bivariate analysis, there was no statistically significant association between the knowledge of the nurses and the sociodemographic factors considered. The male nurses (OR 1.74, 95%CI 0.19-15.6), the more experienced ones (OR 1.08, 95%CI 0.43-2.69), the junior rank (OR 1.35, 95%CI 0.55-3.35), and the unmarried among them (OR 1.15, 95%CI 0.24-5.42) had greater odds of obtaining good knowledge scores. The odds of having good knowledge scores were 1.27 times (1/0.79) greater for the younger age category than the older (95%CI 0.32-1.98). Regarding the practice score, work experience was the only factor that was significantly associated with practice. The odds of the less experienced nurses (=<18 years of work experience) having good practice scores was 4 times (1/0.25) greater than that of the more experienced ones (95%CI 0.06-0.94). The odds obtaining good practice scores was 3.33 times greater for the males than the females (95%CI 0.36-31.0). The younger nurses (OR 1/0.34=2.94), senior rank (OR 1/0.46=2.17) and the married ones (OR 1/0.98=1.02) had greater odds of having good practice scores. Furthermore, the knowledge score of the nurses was not significantly related to their practice scores, although those with poor knowledge had 2.08 times (1/0.48) greater odds of having good practice scores than those with good knowledge scores (95% CI 0-3.12).

Discussion

This study was conducted to assess the TBIC-related knowledge and practices of nurse in 2 secondary health facilities in Ibadan, Nigeria, and their association with sociodemographic characteristics of the nurses. The results showed that the mean knowledge and practice scores were of 68.2% and 79.9% respectively. Furthermore, with the cut-off score for good knowledge and practice scores set at 80% and 100% respectively, it was found that only 10.5% and 6% of the nurses had good TBIC-related knowledge and practices respectively. The poor levels of TBIC knowledge and practice found in this study are consistent with

reports from other studies in Nigeria, where generally, poor levels concerning TBIC have been demonstrated among HCWs [20,21,24].

It is noted here that there are several ways to assess and categorize knowledge and practices concerning TBIC. In the literature, some studies simply stated the mean scores and used this as the cut-off to categorize the scores while others used arbitrary cut-off points [26,28]. Even then, the categories may be varied: (i) good, moderate, and poor ; (ii) good and poor; (iii) good, fair, and poor; and (iv) proper, and improper [9,17,28,29]. The majority of the nurses in this study (>80%) were able to correctly identified the constitutional symptoms of TB (cough of 2-3 weeks duration, bloody sputum, night sweats weight loss and fever). This is somewhat similar to the finding by Bhebhe et al. among HCWS in Lesotho, except that in the Lesotho study, only 53.5% considered fever to be a symptom of TB [9]. Most of the nurses answered correctly the questions related to the mode of transmission of TB. For instance, 95% recognized that TB can be transmitted through coughing (96.5%) and reduction of transmission by employing cough etiquette/hygiene (96%) and opening of windows in a room where there is a TB patient (90%). This agrees with the findings in studies conducted in Lagos, Nigeria and Northwest Ethiopia [25,29]. It is also in conformity with findings from South Africa, where Kanjee et al. reported that "most of the information (knowledge) items were answered correctly by over 70% of respondents with some exceptions" and that the "HCWs were generally well informed about TB transmission" [15]. Similar observations were made in a study involving HCWs in Free State Province, South Africa [17].

The overall mean knowledge score of 68.2% reported in the study is higher than the findings of 61%, and 61.5% reported by previous investigators [9,35]. The poor knowledge level of TBIC is aligns with the results of a study by Woith et al. among HCWs in Russia [36]. In contrast to the poor knowledge noticed in the current study, some previous studies reported "good" or "adequate" TBIC knowledge among HCWs, although lower cut-off points were used in these studies. For instance, Bhebhe et al. reported that 89.2% of HCWs in their study in Lesotho had "appropriate" TBIC knowledge, but the cut-off used to categorize "good" was 70%, which is lower than 80% used in the present study [9]. The mean score of

61.5% reported by them was even lower than 68.2% recorded in the present study. Similarly, Buregyeya et al. reported that 69 % of the HCWs were thought to have adequate TBIC knowledge, with a cut-off of 70% [28]. Using a cut-off of 60%, 74.4% of health professionals in the study by Temesgen and Demissie were found to have "good" knowledge [27].

In terms of practice of TBIC measures, most of the nurses reported scores that were less than 80% as "always" practised for all the 5 items considered. Only 2 out of the 5 items had more than 70% of the nurses reporting them as "always" practised: cough etiquette/hygiene and opening of windows. Ekuma et al. also reported similar poor "always" findings for practice items [25].This was however different from the reports in the South African study by Engelbrecht et al., where 4 items out of 12 had more than 80% of the respondents who "always" practiced them: fast-tracking, screening, window opening, and collection of sputum specimens from coughing patients [17]. Of particular importance, however, is that the frequency of the TBIC mentioned in the South African study, just like in the current study, were self-reported by the respondents. In that study, the researchers noted a discrepancy between self-reporting and observed practices. We noticed in our study that the proportions of nurses reporting various TBIC measures as "always" practised were less than the proportions that recorded correct answers to related questions under the knowledge scale. This discrepancy suggests that although good levels of nurses' TBIC knowledge have been shown to be closely associated with good TBIC practices, it is not its only determinant [17]. Other factors that influence proper TBIC practice include clear TBIC policy directives, appropriate triage system and separation facilities, availability of personal protection equipment, reasonable work load, adequate and well-ventilated clinic space**,** among others [37]. Findings from studies conducted in LMIC, where cost-effective TBIC measures are best suited, are in overwhelming support of the results of the practices in the present study. Inadequate practice of TBIC measures have been reported in Nigeria, South Africa, Lesotho and Ethiopia [10,11,17,29]. Tamir and his co-workers (2016), using 80% as their cut-off, found that only 38% of the HCWs in their study had overall proper TBIC practices [29]. Even where Temesgen and Demissie reported an overall "good" TBIC practice (with a cut-off of 50%- lower than the present study), specific practices were still poor [27]. Poor levels of implementation of TBIC measures were also reported by Bhebhe et al. in Lesotho and Kanjee et al. in South Africa [9,15]. The discrepancy noticed in the proportions with good knowledge and practice between the

current study and previous ones could be due to the different cut-off points and scoring systems used. It is important to note that higher cut-off points were used in the current study. The finding of small proportions of nurses with good levels of TBIC-related knowledge and practices in this study is not completely unexpected as TBIC guidelines had just been released in the country at the time of the study and the implementation of the guidelines was still in its early stages [21,24].

Knowledge was not significantly related to all the socio-demographic factors considered, although the males, the younger ones, the more experienced, junior rank, and the unmarried ones had greater odds of having good scores. For TBIC practice, those with greater odds of obtaining good scores included the males, younger nurses, the less experienced ones, senior rank, and married ones. The distribution of the nurses in terms of sex and marital status was greatly skewed in favour of females (97.0%) and married respondents (91.5%). This pattern reflects the profile of nursing workforce in Nigeria as reported by other investigators [38]. Furthermore, the wide confidence intervals recorded for the separate regression analysis for the two factors as independent variables and knowledge and practice as dependent variables indicate low precision. These elements should be considered when interpreting the results. The findings from the current study on the association between the nurses' TBIC knowledge and socio-demographic characteristics are in conformity with results from previous studies. Temesgen and Demissie revealed that TBIC knowledge among HCWs in Ethiopia were not significantly associated with work experience and age category [27]. Buregyeya et al. noted that age and sex were not associated with TBIC knowledge [28]. Gizaw et al. reported that TBIC knowledge was associated with work experience, with HCWs who had more than six years' work experience in health facility being more knowledgeable than those with less than 3 years' experience (our study had a cut-off of 18 years) [26]. This contrasts with the present study. The lack of association observed between knowledge and age on one hand and marital status on the other, however, agrees with the findings from the present study.

Regarding TBIC practices, according to Mugomeri et al., the nurses' age and TB ward work experience did not significantly influence their practice of TBIC measures [11]. Similarly, Temesgen and Demissie noted that TBIC practices among HCWs in Ethiopia were not related to work experience and age category [27]. In another study conducted in Ethiopia, work experience, age, gender, marital status were not statistically related to TBIC practice [29]. Apart from the finding in the current study of the less experienced nurses having statistically significant greater odds of obtaining good practice scores, there is an agreement with

the observations concerning the other socio-demographic factors from all the previous studies mentioned here. The greater odds for the less experienced nurses may be because they usually work with directives from more experienced ones and carry out the actual work duties while the more experienced nurses perform mainly supervisory and administrative roles, in line with official responsibilities assigned to the different professional levels [39,40]. The association between knowledge and practice was not statistically significant, although the nurses with poor knowledge scores had greater odds of obtaining good practice scores. This should however be interpreted with caution as the 2x2 contingency table showed that there were no nurses with good knowledge score that also had good practice score, hence the use of exact logistic regression approach to produce the point estimate and confidence interval, in line with recommendations by Hosmer and Lemeshow for analyzing cells with zero or sparse counts [41].

The absence of significant association between TBIC knowledge and practice in this study contracts with others reports from South Africa and Northwest Ethiopia, where TBIC knowledge was shown to be significantly associated with its practice [17,27]. It, however, aligned with the finding by Gizaw et al. in Addis Ababa, Ethiopia [26]. Furthermore, TBIC knowledge was reported to be significantly associated with training on TBIC received by the HCWs in the most of the previous studies mentioned [26-28]. Knowledge might not have significantly influenced practice in the present study because at the time of the study, TBIC guidelines had been newly introduced by the national TB Program and structured TBIC training had commenced but nurses at the study sites were yet to benefit from this [16,24]. The findings from this study suggests that diffusion of actions and professional socialization, which influence work practices, might have been entrenched in the routine of the nurses and played a major role in their practice of TB preventive practices, irrespective of their knowledge and other factors such as age, sex and marital status categories, as these were all not significantly associated with their TBIC practices [42,43]. Apart from knowledge, there are other determinants of proper TBIC practices such as TBIC policy, administrative support, infrastructural compliance, among others [37]. The positive influence of TBIC training on the practice of TB preventive measures revealed in previous studies and the well-known interplay of training and knowledge on practice underscore the importance of conducting trainings on TBIC and equipping the nurses with necessary skills to improve their practices [26-28].

Limitations Of The Study

The information on the practice of TBIC measures was obtained from the nurses' self- reports using the study questionnaire. It was difficult to carry out direct observation of the practices by the nurses as this is time-consuming and requires the engagement of more research personnel as observers. There is the likelihood of a discrepancy between self-reported information and direct observation of actual practice, as previously reported by Engelbrecht et al. [17]. Some study participants may have over-reported their performance of TBIC measures because of the social acceptability of being perceived as doing the proper thing (i.e. social desirability bias) [44]. There was no uniformity in the comparison of the mean scores of the participants in this study with scores from previous studies. This was because various cut-off points and scoring systems were used for the levels of knowledge and practices for various studies that were referenced.

Conclusions

This cross-sectional study revealed low proportions of nurses with good knowledge and practice scores concerning TBIC in two secondary health facilities in Ibadan, South West Nigeria. It also shows that the nurses' socio-demographic characteristics were not significantly related to their TBIC knowledge and practice, except for the association between experience and practice. This study has provided information that can be used by policy makers at various levels to plan interventions aimed at improving the TBIC knowledge and practices of nurses and other HCWs. It can also be used as a benchmark for the monitoring and evaluation of TBIC interventions. This is particularly important for settings where the TBIC guidelines have not been optimally implemented. It is recommended that training on TBIC should be provided for the nurses. This will equip them with the knowledge and skills necessary for adequate implementation of TB preventive measures. In addition, health facility managers should ensure constant availability of TBIC equipment and supplies. A system should also be put in place in each health facility for adequate supervision and monitoring of the implementation of TBIC measures. Facility architectural designs and remodeling may also be required to ensure optimal implementation of natural environmental TBIC measures.

Abbreviations

CDC: U.S. Centers for Disease Control and Prevention; CI: confidence interval; DOTS: directly observed treatment short-course; HCW: healthcare worker; HIV: Human Immunodeficiency Virus; LGA: Local Government Area; LMIC: low- and medium-income countries; MDR-TB: multi-drug resistant tuberculosis; MTB: *Mycobacterium tuberculosis;* OR: Odds Ratio; PHC: primary health centre; PLHIV: people living with HIV; PPE: personal protective equipment; PTB: pulmonary tuberculosis; RR-TB: rifampicin-resistant tuberculosis; UVGI: ultraviolet germicidal irradiation; WHO: World Health Organization.

Declarations

Ethics approval and consent to participate

The study was approved by Sefako Makgatho Health Sciences University Research Ethics Committee (MREC/H/271/2013: PG) and Oyo State Ministry of Health Research Ethical Review Committee in Nigeria (AD 13/479/557). Permission was obtained from Oyo State Hospitals Management Board and the management of Adeoyo Maternity Teaching Hospital and Ring Road State Hospital, both in Ibadan, Oyo State, Nigeria. Participation in the study was completely voluntary and measures were taken to ensure privacy and confidentiality of the participants, and written informed consent was obtained from each participant.

Consent for publication

Not applicable.

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

No competing interests declared.

Funding

No special funding was received for this study.

Author’s contribution

PAA conceived the study, conducted the field work, analyzed the study data and drafted both the original thesis report and the manuscript.

Acknowledgements

This manuscript was extracted from PAA's DrPH thesis at the Department of Public Health, School of Health Care Sciences, Sefako Makgatho Health Sciences University, Pretoria, South Africa. The late Professor Ntambwe Gustav Malangu provided overall guidance for the development of the study, supervised the project, and reviewed the thesis report. Special thanks to the faculty at the Department of Public Health, Sefako Makgatho Health Sciences University, Pretoria, South Africa; Oyo State Hospitals Management Board and Oyo State Ministry of Health, Nigeria; and the management of, and nurses at Adeoyo Maternity Teaching Hospital and Ring Road State Hospital, both in Ibadan, Nigeria. This work is dedicated to the memory of the late Professor Ntambwe Gustav Malangu.

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Tables

Table 2: Distribution of participants with correct responses (N=200)

Knowledge item	n	%
Symptoms of PTB		
Blurry vision (False)	108	54.0
Coughing for longer than 2-3 weeks (True)	199	99.5
Coughing up blood (True)	197	98.5
Ear pain (False)	106	53.0
Fever (True)	176	88.0
Memory loss (False)	118	59.0
Night sweats (True)	191	95.5
Pain with urination (False)	153	76.5
Watery eyes (False)	90	45.0
Weight loss (True)	195	97.5
Mode of spread and risk of TB		
TB can be spread to others through semen or vaginal fluid (False)	175	87.5
TB can be spread to others through the air (True)	193	96.5
TB can be spread to others through contact with blood (False)	153	76.5
Patients with TB disease can infect other people by coughing (True)	193	96.5
Patients with TB disease can infect other people by sharing food (False)	87	43.5
Patients with TB disease can infect other people by talking or singing (True)	90	45.0
Patients with TB disease can infect other people by sneezing (True)	178	89.0
Patients with TB disease are more likely to infect others if they cough up a lot of sputum (True)	182	91.0
Treating TB patient with the right drugs does not affect how infectious they are (False)	90	45.0
Healthcare workers in the outpatients clinic have the same risk of getting TB as any other person (False)	15	7.5
An HIV-positive person has the same risk of getting TB as an HIV-negative person (False)	46	23.0
An HIV-positive staff member cannot get sick with TB if they practise TB infection control measures (False)	43	21.5
It is alright for HIV-positive staff who are healthy to work in TB high risk areas of the hospital (False)	134	67.0
TB infection control measures		
When entering the outpatients clinic, every patient should be asked if they are coughing (True)	136	68.0
Patients who are identified as presumptive TB cases should not be separated from other patients in the waiting area as this will be seen to be discriminating against them (False)	117	58.5

ı coughing/sneezing patient should be instructed to cover their mouth with a handkerchief, tissue or their arm while oughing/sneezing (True)	19296.0
: coughing/sneezing TB patients or presumptive cases use handkerchief or tissue to cover their mouth while oughing or sneezing, that is usually enough to protect the healthcare worker (False)	97 48.5
: a coughing patient has not been diagnosed as a case of TB, it is not necessary to instruct them to cover their mouth vhile coughing (False)	17386.5
ı coughing patient should be instructed to collect a sputum sample in the clinic toilet (False)	79 39.5
)pening windows in a room with a coughing patient has no effect on the spread of TB (False)	13869.0
: a fan is used in a room, opening windows will not provide additional benefits for TB infection control (False)	15477.0
'he windows in a room where there is a TB patient should not be opened because they have to be hidden from other eople (False)	18090.0
'resumptive TB cases in the waiting area should wait just as long as everyone else, and should not be rushed nrough the queue (False)	11859.0