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

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Research article

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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 more experienced nurses (>18 years of experience) having lesser odds of obtaining good practice scores (OR 0.25, 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.

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. It can also 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].

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 is generally higher than in the general population [3-6]. This risk is worsened by the increased exposure of HCWs to infectious TB patients, especially where there is inadequate implementation of TB infection control (TBIC) measures [7-9]. 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 recommended the adoption of several TB infection control measures [10]. These include (i)managerial measures; (ii)administrative measures- which are considered the first priority even in resource-limited settings;(iii) environmental control measures; and (iv) Personal protection equipment (PPE) e.g. particulate respirator. Simple, practical and cost-effective interventions be adopted in most low- and medium-income countries (LMIC) to reduce the exposure of HCWs to infectious TB patients [11]. TBIC measures have been successfully implemented in most high-income countries and in some resource-limited settings [12]. Poor implementation of the control measures by HCWs has however been reported [13-15]. The adoption of TBIC practices by HCWs is known to be positively influenced by good knowledge regarding occupational TB exposure [16,17]. 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 [9,18]. 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 [19].

Surveys have been conducted in Nigeria to assess the level of implementation of TBIC practices in health facilities, with generally poor results. At the time of this study, despite the availability of national guidelines for the implementation of TBIC, the policy was still trickling down to lower levels, training was ongoing but not yet widespread, and administrative measures were yet to be put in place in most facilities providing care for TB patients [14,18,20]. 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 [21,22]. 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 address individual HCWs are either focused on personnel in specific units in health facilities such as DOTS workers or diffusely include general HCWs [23-24]. The results from these studies show gaps in TBIC-related knowledge, especially regarding TBIC, and the actual practice of the measures. 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 [25]. Other studies in Northwest Ethiopia and Uganda did not show any significant association between TBIC knowledge and age or work experience [26,27]. TBIC practice was not observed to be associated with age, work experience and marital status of the HCWs by some investigators [9,25,28]. Furthermore, TBIC practice was reported to be significantly related to its knowledge in studies in South Africa and Ethiopia [15,26].

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

Methods

Study design and setting

The 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) [29,30]. Oyo State has the third highest TB burden in Nigeria, with 6901 cases reported in 2017 [31].

Study population and sample

The study population consisted of nurses who work at two secondary health facilities in Ibadan metropolis: Ring Road State Hospital and Adeoyo Maternity Teaching Hospital. The study sites were purposively selected and are located in 2 separate local government areas (Ibadan North and Ibadan South-West respectively). Based on available administrative data, 173 and 217 nurses respectively at these facilities made up the study population (total= 390). 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%) [32]. A sample size of at least 198 nurses was determined. To compensate for non-response, this was increased by 10% to 218. The facilities were proportionately allocated sample sizes of 123 and 96 respectively (both approximated to the nearest decimals). However, all available nurses at the study sites were encouraged to participate because of the public health and health system benefits of the study.

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. [13] to study TBIC in a high drug-resistance setting in South Africa. To ensure the instrument items were relevant, adequate and appropriate, subject matter experts (2 consultant

chest physicians and 2 senior TB nurses) examined it for face validity while the review undertaken by the Sefako Makgatho Health Sciences University Research Ethics Committee served the purpose of improving its content validity. Based on expert opinions, some of the initial instrument items were deleted and others rephrased. The knowledge and practice scales were found to have acceptable internal consistency, as determined by Cronbach's alpha of 0.6 and 0.8 respectively. The questionnaire was pilot-tested at one of the study sites on 15 nurses who were eventually excluded from the main study. Their understanding of the questions and challenges encountered in responding to them were utilized to rephrase some of the questions for clarity. The study instrument was drafted in English and there was no need to translate it as this is the official language used by the respondents and the medium of instruction during their training. The final 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 scale had a maximum possible score 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, the self-administered questionnaire was issued out and this was returned after completion by the nurse. The study was conducted in May 2014.

Statistical Analysis

STATA version 13 was used to analyse the study data. Descriptive statistical methods were utilized to show 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 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 was used to determine associations between socio-demographic dichotomous categories as independent variables and TBIC knowledge and practice scores as separate dependent variables (both having dichotomized outcomes of "good" and "poor"), as well as between their knowledge scores (independent

variable) and practice scores (dependent variable). Both for the descriptive statistics and logistic regression, the socio-demographic factors examined were categorized as follows: age (using the median age of 44 years as cut-off point for those 44 years or less, and above 44), work experience (18 years or less, and above 18 years, with the median age of 18 years as cut-off), sex, and marital status (married and unmarried). Professional hierarchy was also categorized into the senior category (Principal Nursing Officers, Assistant Chief Nursing Officers and Chief Nursing Officers) and junior (Nursing Officers and Senior Nursing Officers). 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 both study sites. 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. In order to ensure anonymity of the participants, their name, address and other unique identifier were not included in the questionnaire. The participating facilities and individual participant questionnaires were allocated identification numbers, to which the participants could not be linked.

Results

At the facility with the larger sample size, 100 nurses out of the required 123 returned their completed questionnaires. An additional 4 nurses voluntarily took part in the study at the facility that had an initial sample size of 96 allocated to it, bringing the total to 100. Overall, 200 out of the 219 questionnaires distributed were returned by the respondents (response rate= 91%).

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%) and married (91.5%). More of them were also in the senior professional category (59%).

TBIC knowledge and practices of respondents

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

Knowledge item	n	%
Symptoms of PTB		
Blurry vision (False)	10	854.0
Coughing for longer than 2-3 weeks (True)	19	999.5
Coughing up blood (True)	19	798.5
Ear pain (False)	10	653.0
Fever (True)	17	688.0
Memory loss (False)	11	859.0
Night sweats (True)	19	195.5
Pain with urination (False)	15	376.5
Watery eyes (False)	90	45.0
Weight loss (True)	19	597.5
Mode of spread and risk of TB		
TB can be spread to others through semen or vaginal fluid (False)	17	587.5
TB can be spread to others through the air (True)	19	396.5
TB can be spread to others through contact with blood (False)	15	376.5
Patients with TB disease can infect other people by coughing (True)	19	396.5
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)	17	889.0
Patients with TB disease are more likely to infect others if they cough up a lot of sputum (True)	18	291.0
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)	13	467.0
TB infection control measures		
When entering the outpatients clinic, every patient should be asked if they are coughing (True)	13	668.0
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)	11	758.5

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 hile coughing (False)	17386.5
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 rough the queue (False)	11859.0

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 included 2 items that have to do with cough hygiene and keeping windows open in a room with a coughing patient.

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 (%)
›w 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)
›w 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)
›w 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)
›w 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)
›w 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)
›w 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 regard to the frequency 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 instruction on cough etiquette (74.5%). Separation of coughing patients to a different waiting area had the least proportion of nurses that practised this always (26.5%)..

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. Likewise, the majority of them (94.0%) had poor practice scores based on the cut-off of 100%.

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

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. Regarding the practice score, work experience was the only factor that was significantly associated with practice. The more experienced nurses (>18 years of work experience) had less odds of obtaining good practice scores than the less experienced ones (OR 0.25, 95%CI 0.06-0.94). Furthermore, the knowledge and practice scores were not significantly related, although the nurses with good knowledge scores had less odds of obtaining good practice scores (OR 0.48, 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 they had mean knowledge and practice scores 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 observed that the majority of them had poor TBIC-related knowledge and practices. This is consistent with reports from other studies in Nigeria, where generally, poor levels concerning TBIC have been demonstrated among HCWs [18,19,23,24].

Several ways of assessing and scoring TB-related knowledge and practices were observed in the literature. While some studies simply stated the mean scores and used this as the cut-off to categorize

the scores, others used arbitrary cut-off points [25,27]. 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 [7,15,27,28]. 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 [7]. 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 [24,28]. It is also agrees 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” [13]. Similar observations were made in a study involving HCWs in Free State Province, South Africa [15].

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 [9,33]. The poor knowledge level of TBIC aligns with the results of a study by Woith et al. among HCWs in Russia [34]. In contrast to the poor knowledge noticed in the current study, some researchers have previously 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 define “good” was 70%, which is lower than 80% used in the present study [7]. Also, the mean score of 61.5% reported by them was lower than 68.2% recorded here. Similarly, Buregyeya et al. reported that 69 % of the HCWs were thought to have adequate TBIC knowledge, with a cut-off of 70% [27]. Using a cut-off of 60%, 74.4% of health professionals in the study by Temesgen and Demissie were found to have “good” knowledge [26].

In terms of practice of TBIC measures, 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 [24].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 [15]. 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-reports 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 [15]. Other factors that influence proper TBIC practice include clear TBIC policy directives, appropriate triage system and separation facilities, availability of personal protection equipment,

reasonable workload, adequate and well-ventilated clinic space, among others [35]. 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 [8,9,15,28]. 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 [28]. 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 [26]. Poor levels of implementation of TBIC measures were also reported by Bhebhe et al. in Lesotho and Kanjee et al. in South Africa [7,13]. 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 a large proportion 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 and many facilities, including the study sites, had not been benefited from the roll-out package. [14,19,20,23].

Knowledge was not significantly related to all the socio-demographic factors considered. 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 [36]. Furthermore, the wide confidence intervals recorded for the regression analysis for the two factors as separate 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 [26]. Buregyeya et al. noted that age and sex were not associated with TBIC knowledge while 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) [25, 27]. This is at variance with the present study. The lack of association observed between knowledge and age, however, agrees with our findings.

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 [9]. Similarly, Temesgen and Demissie noted that TBIC practices among HCWs in Ethiopia were not related to work experience and age category [26]. In another study conducted in Ethiopia, work experience, age, gender, marital status were not statistically related to TBIC practice [28]. Apart from the finding in the current study of the more experienced nurses having statistically significant less 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. That the more experienced nurses are less likely to obtain good practices may be because most of them, who are usually in the senior cadre, serve as unit heads/managers and their work duties include

mainly managerial functions such as establishing patient care goals, managing work schedule and roster, ensuring compliance with work policies and protocols, commodity management, coordinating review meetings, among others. They may not necessarily carry out actual TBIC practices, in line with official responsibilities assigned to the different professional levels. Some investigators in Nigeria have reported that nurse managers tend to focus more on their managerial duties at the expense of their clinical roles [37,38]. 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 scores that also had good practice scores, 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 [39].

The absence of significant association between TBIC knowledge and practice in this study contracts with reports from South Africa and Northwest Ethiopia, where TBIC knowledge was shown to be significantly associated with its practice [15,26]. It, however, aligned with the finding by Gizaw et al. in Addis Ababa, Ethiopia [25]. 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 [25-27]. 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 [14,23]. The findings from this study suggest 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 most of the socio-demographic factors, as these were mostly not significantly associated with their TBIC practices [40,41]. 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 [25-27].

Limitation of the study

It was difficult to carry out direct observation of TBIC practices by the nurses as this is time-consuming and requires the engagement of more research personnel as observers. Self-reports were relied on and there is the likelihood of a discrepancy between this and direct observation of actual practice, as previously reported by Engelbrecht et al. [15]. There could be over-reporting of the performance of TBIC measures by the participants because of the social acceptability of being perceived as doing the proper thing (social desirability bias). For the purpose of having an all-inclusive sample, the participants included nurses in all the units of the hospitals (out-patient units, wards, emergency room, operating theatre, among others). Various schedules and duties are involved in the different units although the nurses rotate through all of them, and some of their assigned tasks may not be directly related to TB care. Also, some of the them might not have been involved in TB care in the recent past and this could possibly affect their response to the practice items (recall bias). The study questionnaire tended more toward

administrative and environmental control measures (specifically, natural ventilation systems) as managerial measures are more in the purview of facility management and personal protection equipment (respirators) are mostly available for use in specialized DR-TB care facilities. For the implementation of an integrated package of TBIC interventions, it would be beneficial to have further review of the instrument to make it more exhaustive.

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, 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 to 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; 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.

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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.

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