American Journal of Public Health Research, 2023, Vol. 11, No. 3, 107-116
Available online at http://pubs.sciepub.com/ajphr/11/3/4
Published by Science and Education Publishing
DOI:10.12691/ajphr-11-3-4

Role of Attitude in Influencing Compliance with Tuberculosis Infection Prevention and Control Guidelines among Healthcare Workers

Janeffer Muthoni Wangari[1], Emmah Mwangi[2], Washington Auma Arodi[3,*]

[1]Department of Environmental and Occupational Health, Kenyatta University, P.O Box 74714-00200 Nairobi, Kenya
[2]Department of Environmental and Occupational Health, Kenyatta University, Nairobi, Kenya
[3]Department of Medical Laboratory Sciences, Kenyatta University, Nairobi, Kenya
*Corresponding author: wangajen@yahoo.com, janeffermuthoni2019@gmail.com

Received April 08, 2023; Revised May 13, 2023; Accepted May 24, 2023

Abstract **Background**: Tuberculosis is a major occupational hazard among healthcare workers, not just in Kenya but globally due to consistent and routine exposure. This is especially true among the nurses and laboratory workers among the professional cadre who are regarded as high-risk groups for both Latent Tuberculosis Infection (LTBI) as well as active TB, with the lowest risk noted among the administrative staff. The escalated occupational cases were associated with poor implementation of the full hierarchy of IPCs as outlined by the World Health Organization (WHO), especially administrative control. This study was a cross-sectional study that was conducted at Kenyatta National Hospital and Mbagathi District Hospital, Nairobi County. **Objective:** The study sought to find out the influence of the attitude of HCWs on TB IPC guidelines in Kenyatta National Hospital and Mbagathi District Hospital. **Materials and methods:** The study adopted a descriptive cross-sectional community study design. The study utilized qualitative and quantitative research methods in order to obtain the required information from respondents. Quantitative data collection was done by use of semi-structured, self-administered questionnaires while qualitative data was collected through Key Informant Interviews (KII) and standardized observation checklists among Health Care Workers (HCWs), specifically nurses and laboratory staff. Confidentiality of information collected was observed and consent was sought from the respondents before collecting any form of information from them. A total of 38 nurses and 4 laboratory staff from Mbagathi District Hospital and 332 nurses and 32 laboratory staff from Kenyatta National were randomly selected (n=406). The response rate was 98% with 398 participants having completely and accurately filled and returned the questionnaires. The tools that the researcher used included questionnaires, interview schedules, pens and pencils. Descriptive data was analyzed with the aid of the Statistical Package for Social Sciences (SPSS) version 22.0 with the help of the Microsoft Excel program to generate frequency tables, graphs, and pie charts. Inferential statistics were calculated using Chi-Square tests (p=0.005) done at a 95% confidence level to determine the linkage between the Variables. **Results:** The attitude level was reported at 72.1% (good) with most respondents indicating that they had a higher risk of acquiring the infection and although they knew about the disease, they expressed concern about being infected while in the line of duty. Further, perceptional survey audits are conducted as random spot checks periodically to ensure that the staff attitude improves. **Conclusion**: The study findings revealed that there is a dire need to develop and implement a robust occupational health management system that takes cognizance of development and adherence to sensitization framework; accurate and prompt surveillance and reporting of TB; supportive legal framework; committed leadership; financial investment and strict/stringent measures in place to ensure compliance to set guidelines.

Keywords: *health care workers, nosocomial tuberculosis, hierarchy of control, infection, prevention and controls (IPC), compliance*

Cite This Article: Janeffer Muthoni Wangari, Emmah Mwangi, and Washington Auma Arodi, "Role of Attitude in Influencing Compliance with Tuberculosis Infection Prevention and Control Guidelines among Healthcare Workers." *American Journal of Public Health Research*, vol. 11, no. 3 (2023): 107-116. doi: 10.12691/ajphr-11-3-4.

1. Introduction

Tuberculosis (TB) is a bacterial infection caused by Mycobacterium bacilli through inhalation of aerosols released by an infected untreated person through sneezing, coughing, laughing, singing or even talking. The airborne particles are suspended in the air and can be carried afar. Once inhaled, the mycobacterium bacilli lounges into the lungs where immune cells engulf it for degradation. It may

be dormant forming a granuloma hence Latent Tuberculosis Infection may develop into a disease where it's then disseminated hematogeneously thought-out the body [1]. It is screened using Tuberculin Skin Test (TST) or Interferon Gamma Release Assay (IGRA). The sputum is collected and analyzed through slide microscopy, molecular assay (Xpert MTB/RIF assay) or through conventional culture and Drug Sensitivity Testing. Chest radiography is carried out as a confirmatory test for pulmonary TB [2]. Some of the TB risk factors include malnutrition, pregnancy, cigarette smoking alcohol consumption and chronic infections like cancer and diabetes mellitus [3].

In healthy adults exposed, only 5-10% develop the disease in their lifetime, mostly within the first and second year of exposure. According to WHO report in 2013 October, a third of the world's total population had the disease with 9 million getting infected annually hence causing 2 million mortality cases annually. In addition, the increase has been escalated by the co-infection with HIV/AIDS as well as the emergence of Multidrug-Resistant TB (MDR-TB) hence a significant increase in morbidity and mortality cases. For instance, in 2015, 10.4 million got the disease, 1.2 million (11%) had a co-infection with HIV while 480,000 persons developed multi-drug resistant strains (MDR-TB) with 100,000 requiring a second line of treatment [4]. According to the Division of Leprosy, Tuberculosis and Lung Disease in 2013, 288 persons per 100,000 had the disease with 45% of 83% being seropositive [1].

Occupational TB is a major occupational hazard not only in Kenya but also globally despite the clearly outlined TB infection, prevention and controls policy and guidelines by the WHO and International Union of Tuberculosis and Lung Disease (IUTLD) [5,6]. Poor implementation especially the administrative control in the hierarchy is the major contributor to this public health menace yet this measure is cost-effective and also very attainable at any given healthcare facility [7]. From the research conducted, most facilities were congested; those coughing "TB suspects" had no separate waiting areas, and no tissue or surgical masks were offered to suspects with inadequate ventilation in high-risk areas like waiting bays, medical wards, TB wards and Laboratory areas. The HCW's job cadre most regarded as the high-risk group includes professional nurses, laboratory staff, nursing and medical students [8,9].

However, all the HCWs are at risk of contracting the disease with the prevalence being three times higher than the general population [8,10]. This is the true picture in Kenya where the study was done in both Central and Western regions. The escalation of HIV/AIDS is seen as a contributing factor to the incidence of not only TB but also the emergence of Multi-drug resistance strains and extremely drug-resistant strains (XDR-TB) in Kenya. This is due to the duration of exposure from the patients they are attending to, to the dose of the bacilli droplet nuclei concentration in the air they are inhaling. The attributable risk is higher in facilities with TB admission wards and whose number of HCWs attending to them is few thus longer times spent constantly on the patient's bed [6,11].

However, the adherence to TB IPC in a healthcare set-up, administrative, environmental and Personal Respiratory Protective measures (PRP) supported by the managerial team is seen as the remedy to occupational TB [12]. This has been shown to reduce the incidence of TB by 27%-81% based on the country's burden [13].

2. Literature Review

2.1. Introduction

Mycobacterium tuberculosis is an obligate pathogenic bacterium under the family of Mycobacteriaceae. It is a non-spore-forming bacteria, aerobic, non-motile and acid-fast bacillus. When stained with arlymethane dyes e.g auramine, rhodamine or carbolfuchsin, the latter being the most commonly used, appears as purplish-red beads in a chain form [14]. It does not stain using gram stain. The infectious dose for TB is 1-10 organisms though there is no "safe" level of exposure since this is independent of an individual's level of immunocompetence. Therefore, healthcare personnel have a greater risk of contracting the disease during the processing of the "suspected" specimens. Mycobacterium tuberculosis does not segregate age or status and therefore can be found in both neonates/infants as well as adults; toddlers and infants having a risk of 40 to 50 percent of developing TB disease whereas adults having a risk of 5 to 10 percent of developing TB disease within their lifetimes [15].

Infection, Prevention and Control (IPC) measures are guidelines and policies that have been recommended by both the WHO and IUTLD in healthcare facilities in regard to nosocomial Tuberculosis among Healthcare workers as well as patients. Nevertheless, much has not been done in adhering to the policies, especially in Low Income and Middle-Income Countries (LMICs) yet that is where the TB risk is very frequent. This is attributed to majorly; limited resources that would assist establish the hierarchy control measures, an emphasis being engineering controls and Personal Respiratory Protectors (PRP) [12].

2.2. Tuberculosis among Health Care Workers

Occupational TB is a major concern especially in regard to health care workers (HCWs) with research indicating that a range of 25-5,361 persons per 100,000 per annum less than 10 persons in 100,000 per annum in low-middle income countries and high-income countries respectively. In the former category, 54% of all HCWs have LTBI with a significant increase noted in those who had a longer exposure in isolation rooms and longer duration of employment. According to NLTD report, the duration of exposure, proximity to the source and the concentration of the bacilli droplets in the air in relation to ventilation available greatly contributed to the LTBI converting to active TB [1]. This too was the replica in both medical and nursing students. The number of nosocomial cases was significantly low in developed countries due to stringent guidelines for the prevention of

TB being in place and vice versa in developing countries as a result of limited finances thus low or no strategic plans in place. However, good work practice and administrative control measures, according to the WHO have the greatest impact on the prevention of TB transmission in healthcare setting [16].

In high-income countries, the following are the main strategies established in the prevention of the disease in workers especially, the nursing staff and laboratory personnel. Namely; standard diagnostic and prompt treatment plan as an administrative control-to patients confirmed with TB and those suspected of it; also the creation of isolation rooms as an environmental control- to minimize droplets concentration in the air hence reducing the transmission and finally respiratory protection control as part of the Personal Protective Equipment (PPE) especially where TB is unavoidably high in concentration [17]. Tuberculosis, however, is seen as a major occupational hazard among healthcare workers, not just as a nation but globally due to consistent and routine occupational exposure [8]. This is especially true among the nurses and laboratory workers among the professional cadre who are regarded as high-risk groups for both Latent Tuberculosis Infection (LTBI) as well as active TB, with the lowest risk noted among the administrative staff. This was confirmed by research carried out in Kenya between 2010 and 2013 in both Makindu and Kiambu District hospitals [13]. Another category that seemed to be affected is both medical and nursing students [2].

In a study done in Kigali Rwanda, HCW's TB prevalence was at 62% compared to the general population which was 39% [8]. This public health challenge has an increased risk of infection among healthcare workers compared to the general population [6]. The risk of contracting TB is three times more among the former group [8,10]. It was noted that in hospitals with a high number of admissions, TB patients posed a higher risk of transmission with the annual risk of TB infection (ARTI) going as high as 11.3% with the exception of the pediatric ward. In studies conducted in Russia and South Africa, the TB disease was higher among Healthcare workers than the general population with attributable risk ranging from 25-5,361 cases per 100,000 and less than 10 cases per 100,000 persons per annum in LMICS and High-Income Countries (HICs) respectively. The declined occupational TB cases were associated with the implementation of a full hierarchy of IPCs as outlined by WHO [17]. Co-morbidity with HIV/AIDS has escalated the TB disease with the risk per annum being at 10% among seropositive persons compared to 10% risk in healthy individuals in a lifetime [7,10].

The fact that most hospitals provide both HIV and TB treatments/services co-currently, the risk of TB infection among the seropositive especially when there is a lapse in TB IPC adherence escalates posing a major public health challenge. According to a retrospective study done in Western Kenya Kisumu region on TB and Latent TB infection among HCWs in 2013, the prevalence of self-reported history of TB was higher among the HCWs than the general population with 7.4% and 3.6% respectively. The major contributing factor being HIV/AIDS among HCWs. Negligence of TB IPC policies and guidelines was observed too [5].

2.3. TB Presentation and Prevalence

Tuberculosis is a pandemic disease that poses a major public health challenge not just to developing nations but the world at large since its emergence in 1993. Its re-emergence and evolvement into a multi-drug resistant strain (MDR TB) has further complicated the challenge. MDR-TB is commonly due to non-compliance in patients as well as incomplete anti-TB therapy among the less privileged such as immigrants and the homeless [18]. In 2006, the WHO launched a stop TB strategy that was linked to the Millennium Development Goal 6 in ensuring the reversal of TB spread by 2015. In addition, WHO published and issued a comprehensive report on 23rd October, 2013 which showed that a third of the total world's population was already infected by the tubercle bacilli. The report further showed that nine million people developed tuberculosis every year with two million mortality cases [11,19].

However, in 2015, the WHO gave a successful report achieved but also pointed out the need to have political and funder assistance with its vision targeting mortality deaths by 50% the same year. According to the report issued in 2012, TB seemed to have decreased steadily by 2% with 8.6 million people. The mortality cases were 2.9 million women and 530,000 children with 320,000 recorded among the people living with HIV and AIDS (PLWHA). In the same year, 450,000 cases of MDR tuberculosis were reported with an estimate of 170,000 deaths. It is paramount to note that a third of total deaths occurred in South East Asia with South Africa and India ranking third globally. In addition, it was reported that in 2015 approximately 10.4 million persons got infected with 1.2 million co-infected with HIV; 480,000 patients developed multidrug-resistant TB with 100,000 more requiring a second line of treatment. The mortality cases stood at 1.8 million with 0.4 million as seropositive. By 2016, 49 million lives were saved and a remarkable 22% drop in mortality cases, between the years 2000 and 2015 [10,20].

It was also noted that approximately 3 million people were not included in the report issued either because they were either not diagnosed or were diagnosed but never reported. Moreover, a fifth of MDR cases were detected but not treated, which poses a greater threat to the spreading of MDR TB at both regional and global levels hence a dire need for the United States $2Billion aid per year to fight the disease. The United Kingdom Government's Department for International Development (DFID) also committed to not only donate £ 1Billion between 2014-2016 but also deliver free treatment to 1 million persons infected with tuberculosis [11]. In 2015, a global TB strategy framework was put in place that would run through 2025 and with the introduction of new vaccines and effective treatment for LTBI persons, would achieve Sustainable Development Goals (SDG) 2030 and end the TB pandemic by 2035. To achieve the target that included; a reduction of deaths by 75% and TB incidences by 50% as well as a death reduction by 95% with a 90% incidence rate in the year 2025 and 2035 respectively, three pillars and components were put in place. The pillars include; the provision of integrated patient control and prevention; establishment and integration of bold policies

and support systems and finally carrying out intensified research and innovations [20].

In sub-Saharan African countries, TB still poses a major public health problem. This is majorly due to limited resources, sometimes insufficient trained personnel and heavy workload among others [21]. The challenge has been confounded by high prevalence and incidences of HIV/AIDS disease with 7-10% of persons with untreated HIV infection developing the TB disease per year [22]. Kenya collectively contributes 80% of the global TB disease burden. It falls under one of the 22 high TB burden countries globally(15^{th} position) with the epidemic majorly noted among the young economically productive age groups between 15-44 years and more cases reported among men than women with a case notification rate of 440 cases per 100,000 persons [23]. The incidence of TB is 10 times more than it was since its emergence in the 1990s due to HIV/AIDS prevalence. The PLWHA were the most affected due to low socio-economic status that contributed to poor nutrition, peri-slum dwellings and limited/inaccessible health facilities [24].

WHO estimated that the TB prevalence rate in Kenya was 70% by 2007, representing strictly the cases that were diagnosed and treated accordingly [25]. According to the Division of Leprosy, Tuberculosis and Lung Disease, 110,251 TB cases were reported in 2008. This implies that 288 per 100,000 populations had the disease with 45% of the 83% of patients being seropositive. [26]. In 2017, the government of Kenya had projected a national Tuberculosis budget of US $62 million with 41% of the funds to be sourced internationally while 18% more to be domestically collected. However, the other 41% remained unfunded thus posing a challenge in fighting the disease. According to a report released by the National Tuberculosis, Leprosy and Lung Disease Division (NTLD), the household prevalence survey as of 2016 was 558 cases per 100,000 persons whereas 40% remained undiagnosed hence untreated. This poses a danger of further transmission and may lead to increased cases of multidrug resistance among the infected [27] It is noted that by treating both the latent TB as well as the TB disease cases, the 2030 Stop TB target aimed at eliminating the disease will be realized [28].

HCWs are at the forefront of the battle against tuberculosis (TB), a disease that – because it is airborne – creates a precarious working environment for them. This is especially the case in low- and middle-income countries with a high TB prevalence, where HCWs are at an increased risk of infection due to being exposed to greater numbers of TB patients over long periods of time Poorly implemented, and sometimes even absent, infection control measures as well as a high prevalence of undiagnosed TB in healthcare facilities, further compound the risk to HCWs of TB infection. Moreover, there is very strong evidence that, for HCWs, TB is an occupationally acquired disease as evidenced by the high prevalence of *latent* TB infection (LTBI) among HCWs compared to the general population. Earlier research found that HCWs may even be up to three times more likely to acquire TB than the general population. Furthermore, they are six times more likely to be hospitalized for drug-resistant TB (DRTB) than the population they care for [29].

2.4. Attitude Factors on TB IPC Guidelines

Upon inhalation of the mycobacterium bacilli into the lungs, the immune cells engulf it for degradation. However, the latent tuberculosis infection may develop into active TB, especially with routine exposure to bacilli, the dosage and duration spent by HCWs on patients suffering from the disease. There are two major factors that influence occupational TB among HCWs, namely, exogenous factors and endogenous factors. Endogenous factors are host-related factors and play a key role in acquiring the disease. The risk of progression from exposure to tuberculosis bacilli to the development of active disease is a two-stage process governed by both Exogenous factors and endogenous risk factors [30].

Exogenous factors play a key role in accentuating the progression from exposure to infection among which the bacillary load in the sputum and the proximity of an individual to an infectious Tb case are key factors. In addition, these factors are determined by an intrinsic combination of the infectiousness of the source case, proximity to contact, social and behavioral risk factors since they weaken the cell-mediated immunity. It includes; chronic diseases and their regimen e.g. Diabetes mellitus (DM), chronic renal failure (CRF), cancer treatment among others; also surgeries and solid organ transplants (where suppression of immunity is carried out to minimize incompatibility); in malnutrition/underweight cases; old age; intravenous drug use especially where HIV is a risk factor; unhealthy lifestyles like tobacco smoking and alcohol dependency; pregnancy as well as in persons who had previously undergone TB treatment [31].

The above risk factors generate diverse health outcomes/consequences that range from TB treatment failure to increased TB relapse to even death. In pregnant mothers, the outcome can be premature birth and perinatal death while for those with TB relapse may develop multidrug-resistant TB and poor treatment outcome. It is important to note that failure to early diagnosis and prompt treatment of the persons TB, leads to further transmission of the disease in the community while the patient runs the risk of having poor treatment outcome, financial constraints as well as health sequelae [32].

Socioeconomic and behavioral factors play a significant role in an individual developing active TB. The HCWs in low- and middle-income countries whose socio-economic status is considered low, increases an individual's susceptibility to infection. This is attributed to poor nutrition, indoor air pollution due to residing in crowded and less-ventilated spaces, alcoholism, among others. Male gender was observed to be more affected by TB due to behavioral factors that include though not limited to alcohol taking and smoking. The latter comprises the performance of the lungs leaving it highly susceptible to developing TB from a dormant LTBI [33].

2.5. Summary of Literature Review

Generally, the risk of healthy individuals progressing from latent TB infection to active TB is 5-10% in a lifetime while in people living with HIV/AIDS (PLWHAs) is 12-20 times greater. According to WHO global report in

2015, out of the total annual TB-infected persons, 10.4 million, 11% were those who were seropositive and attributed to one-third of total mortality cases among the AIDS Tuberculosis. It is evident that the death of co-morbid persons is twice higher compared to seropositive's without active TB. Moreover, seropositive persons have a thirty times greater risk of contracting TB than seronegative persons. This therefore calls for vigilance in ensuring the implementation of TB IPC in our health facilities [3]. Kenya was ranked number fifteen out of the twenty-two countries with a high TB burden and according to the Ministry of Health (MoH) report in 2012, Nairobi led in TB prevalence totaling 20,102 cases with 6.3% of total deaths in Kenya and contributing to 4.8% of total Disability Adjusted Life Years (DALYs) [34] and [1]. Furthermore, a study carried out in the Nairobi region in 2008 on the risk of HCWs to TB infection showed that the exposure dose increased in every hour spent with patients and high-risk areas of the facilities thus the prevalence rate stood between 0.6% and 1.1% per annum [35]. Poor implementation of IPCs has not only steadily increased occupational TB in healthcare settings but has also escalated the challenge of emergence and re-emergence of Multi Drug Resistant TB (MDR-TB) and Extensively Drug Resistant TB (XDR-TB) strains especially among the people living with HIV/AIDS (PLWHAs).

This has been noted both in Sub- Saharan Countries as well as Soviet Union Countries [6,11]. According to research done in 2011, it shows that indeed TB is an occupational hazard that if IPC measures are implemented would significantly reduce to as much as 49%, 27%, and 81% TB incidence rates among HCWs in countries with low, intermediate, and high TB incidence, respectively [2]. As per the WHO stratified pools, the incidence rate is categorized into three namely; low, middle and high rates depending on the estimates of less than 50 cases per 100,000 population, 50-100 cases per 100,000 population and more than 100 cases per 100,000 population respectively [2,36]. Tuberculosis among the LMICs is contributed majorly by occupation exposure with a prevalence of 63% (with a range of 33-79%) in HCWs while in HICs, TB was due to no-occupational factors with a 24% rate (range of 4-46%) [12].

It is therefore important to adhere to TB IPCs in healthcare settings if the fight against the disease is to be won and realize the WHO SDG 3 END TB 2030 [20].

3. Materials and Methods

3.1. Study Design

The study employed a descriptive cross-sectional design to access the compliance with TB IPC guidelines among HCWs in Kenyatta National Hospital and Mbagathi District Hospital. Descriptive research depicts the character of the phenomenon/population being studied in its natural setting with no control or manipulation of variables (not answering how/why and when questions thereof) at a specific point in time. It was advantageous to use the design because of the logistics of time and finance at hand.

3.2. Location of the Study

The study location was Kenyatta National Hospital and Mbagathi District Hospital, the two referral government hospitals that would be not only easily accessible but also affordable to the community. These are located in Nairobi County.

3.3. Study Population

The study population comprised nurses and the laboratory staff-technicians and technologists with a total of 2,076 (1,892 and 184 respectively). Mbagathi District Hospital subject participants included 38 nurses and 4 Laboratory staff while for Kenyatta National Hospital were 332 and 4 respectively. These were proportionate to the sample size required with consideration of the hospitals' study populations.

3.4. Sampling Techniques and Sample Size Determination

3.4.1. Sampling Techniques

The two government hospitals were purposely selected considering they are the referral hospitals most visited by the community due to their accessibility, affordability and quality services. Since there are several cadres of HCWs in a hospital setting, each cadre was treated as a stratum. The cadre (Nurses and Laboratory staff) were purposely selected on the basis of the degree of risk they are prone to as shown in the previous studies. The individuals per stratum in each hospital were randomly selected proportionate to the desired sample size of 406 respondents. The Key Informant Interviews included departmental heads of TB wards and Laboratories and IPC leaders.

The study population comprised nurses and the laboratory staff-technicians and technologists with a total of 2, 076 (1, 892 and 184 respectively). Mbagathi District Hospital subject participants included 38 nurses and 4 Laboratory staff while for Kenyatta National Hospital were 332 and 4 respectively. These were proportionate to the sample size required with consideration of the hospitals' study populations.

Table 1. Sampling frame

HOSPITAL	CADRE	TOTAL NO. OF STAFF	PARTICIPANTS
MBAGATHI	Nurses	192	38
	Laboratory staff	21	4
KNH	Nurses	1700	332
	Laboratory staff	163	32
	TOTAL SAMPLE SIZE	**2076**	**406**

3.4.2. Sample Size Determination

Sampling enhances the statistical precision of results by reducing bias which is related to low response rates. Fisher’s et al formula by Mugenda & Mugenda 2003 sampling method was used to determine the sample size.

$$n = \frac{z^2 pq}{d^2}$$

Where:
n = Desired sample size
z = Standard normal deviation at the required confidence level (set at 1.96).
p = From the pre-existing data from [5] research, the prevalence proportion was 60%.

$$q = 1 - p(1 - 0.6)$$

d = level of statistical significance (usually 0.05)

$$n = \frac{\left(1.96^2 \times 0.6 \times 0.4\right)}{0.05^2}$$

n = 369

To cater to non-responses the researcher added 10% of the sample size, totaling 406 participants.

3.5. Data Collection Techniques

The researcher reported to the management of both hospitals after their Ethics Review Committees 'clearances and issued a letter on the same which was submitted to the heads of the departments to permit data collection from the respondents. Quantitative data was collected through semi-structured self-administered research questionnaires. The research assistants were trained on how to create rapport, ensure confidentiality and ways of obtaining consent from the participants. They also administered the questionnaires, collected and checked for completeness and errors. They were monitored, guided and supervised by the researcher's principal. All collected questionnaires were kept in locked cabinets throughout the study period and accessed by the researcher only to ensure confidentiality and avoid data loss. Qualitative data was obtained from the KIIs and the sessions were moderated by the researcher who took notes of the participants' responses. Also, an observation checklist was utilized to observe the HCWs behavior's/ practices in their natural setting as well as the structural design of the facilities for safety.

3.6. Data Management and Analysis

Quantitative data was entered and stored in the Microsoft Excel program. Data cleaning and editing was done where extreme, missing and inconsistent values were identified and corrected. Coding and verification of the data was done for easy manipulation, analysis and presentation. Data were then exported to Statistical Package for Social Sciences (SPSS) software version 22.0 for analysis. The data was analyzed in two levels, first was the descriptive analysis which was done to establish the distribution of the study variables using percentages, frequency tables, charts and graphs. In the second level, inferential analysis was done to test the relationship between independent variables (knowledge, attitude and practices and structural safety). Inferential statistics was done using the Chi-square test (x^2) to measure the significant association between the independent and dependent variables. This was done at a 95% confidence interval and p-values of less than 0.05 were considered significant in testing the association between study variables.

3.7. Logistical and Ethical Considerations

To conduct the research approval was sought from Kenyatta University graduate school. The researcher obtained ethical clearance from Kenyatta University's ethical review committee and permission from the Ministry of Higher Education Science and Technology. The researcher also obtained a permit from the National Commission for Science, Technology and Innovation prior to the conduct of the study. The researcher sought study authorization from the Ethics Review Committees of the two hospitals together with the management heads of the respective departmental units under study. Written informed consent from the participants was sought after the purpose of the study has been explained to the respondents. In addition, every respondent was assured of non-disclosure of the shared information and made aware of the freedom to withdraw from the study if he/she so wished. It was also emphasized that participation was purely voluntary and respondents were free to withdraw from the interview at any point. They were given the freedom to decline to answer questions that may seem to be uncomfortable to them. The respondents' names were not recorded on the questionnaires thus anonymity was enhanced. Their responses were kept confidential and used for the purpose of this study only.

4. Results

4.1. Distribution of Attitude Levels

According to the study findings, 376 (94.5%) revealed that they are afraid of acquiring TB, 336 (84.4%) have had training on TB IPC that makes them comfortable in handling TB patients, 314 (78.9%) have health concerns when it comes to working with TB patients. Further, the results indicated that 204 (51.3%) have local beliefs that they know which makes patients not seek help in a hospital or adhere to treatment, 124 (31.2%) reiterated that respirators are uncomfortable and therefore they prefer not to use while in line of duty. Notably, a majority 331 (83.2%) expressed the need for HCWs exposed to TB patients to undergo TB screening, 79 (19.8%) reported that cough etiquette has no role in TB IPC with 381 (95.7%) stating that they were at a higher risk of developing TB if they are HIV positive.

4.1.1. Attitude Levels

The research sought to determine the attitude levels of the study participants. Regarding respondents' attitudes on compliance with TB-IPC guidelines, a total of 8 statements were provided to the study participants. The respondents were required to fill in the most appropriate response in the form of Yes and No. Out of the 8 statements, a score of less than 3 (0-3) statements or below was categorized as "Poor", a score of 4 to 6 was categorized as "Fair" and Over 6 (7 to 8) was regarded as "Good". According to the study findings, 287 (72.1%) had a fair attitude level, followed by 85(21.4%) who had a good attitude and 26(6.5%) responding as poor as shown in Figure 1 below.

Table 2. The attitude of healthcare workers in relation to Tuberculosis

Statement	Respondent response (Yes/No)	Frequency (n)	Percent (%)
Are you afraid of acquiring TB?	Yes	376	94.5
Have you had any training in TB IPC that makes you comfortable handling TB patients?	Yes	336	84.4
Do you have any health concerns when it comes to working with TB patients?	Yes	314	78.9
Are there any local beliefs that you know that may make patients not seek help in a hospital or adhere to treatment?	Yes	204	51.3
Respirators are uncomfortable and therefore I prefer not to use them in the line of duty.	Yes	124	31.2
Is there any need for HCWs exposed to TB patients to undergo TB screening?	Yes	331	83.2
Cough etiquette has a role in TB IPC.	Yes	315	80.2
I am at higher risk of developing TB if I am HIV positive.	Yes	381	95.7

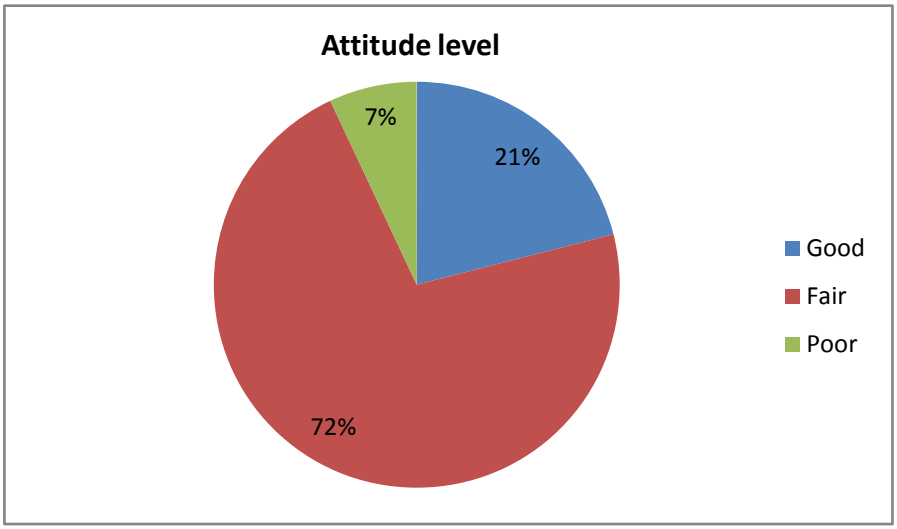

Figure 1. Attitude level

4.1.2. Compliance with TB-IPC Guidelines

According to the study, 62.3% (n=248) comply with TB-IPC standards with 37.7% Starting otherwise. This clearly shows that the compliance level is less than two-thirds of the entire workforce. This calls for training and continuous conscientization. This is inconsistent with a similar study conducted by [37] which revealed that among 662 HCWs, only a third had proper overall TBIC practices.

4.1.3. Association between Attitude and Compliance with TB-IPC Guidelines

The research sought to determine the association between attitude and compliance with TB-IPC guidelines. Table 3 below illustrates the Association between attitude and compliance with TB-IPC guidelines. The study findings revealed that the majority 171 (59.6%) of participants had a fair attitude and comply with TB-IPC guidelines (P=0.034). According to the study findings, participants with good attitude levels are more likely to comply with TB-IPC guidelines (OR=1.688, CI: 1.15, 2.555).

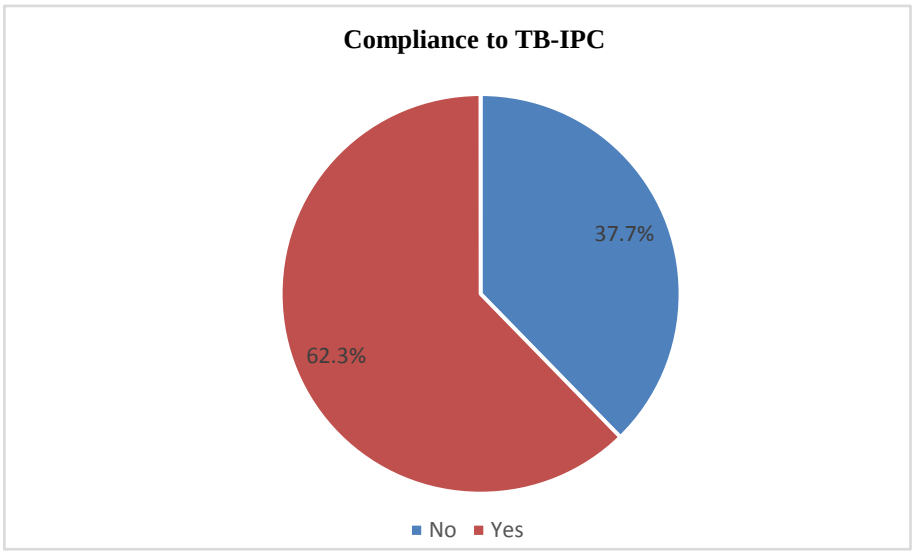

Figure 2. Compliance to TB-IPC

Table 3. Association between attitude and compliance with TB-IPC guidelines

Independent Variable	Respondent response	Dependent variable (Compliance with TB-IPC guidelines)		Statistical significance	OR (95% C.I)
		Yes	No		
Attitude level	Poor	14 (53.8%)	12 (46.2%)	X^2=6.749, P-Value=0.034, Df = 2	1
	Fair	171 (59.6%)	116 (40.4%)		1.345 (1.143,1.582)
	Good	63 (74.1%)	22 (25.9%)		1.688 (1.15,2.555)

5. Discussions

5.1. The attitude of HCWs to Compliance with TB IPC Guidelines

With regard to the attitude of HCWs in relation to TB IPC guidelines compliance, 95.7% of the HCWs revealed that they were at a higher risk of developing TB if they were HIV positive. This has contributed significantly to the health concerns raised when it came to working with TB patients. This also increased the risk of developing multidrug resistance TB strains. Research conducted in Kwa Zulu-Natal, South Africa revealed that the HCWs living with HIV had a greater incidence (two-fold) of TB than the HIV-negative HCWs. The findings emphasized the need to improve infection and prevention measures of TB and drug-resistant wards and high-risk perceived areas such as medical wards, outpatient departments and pediatric wards [10,29]. Further, a majority (94.5%) of them were afraid of acquiring TB with 84.4% having attended a training of TB IPC. A similar study conducted on Occupational Tuberculosis in South Africa revealed training to be low with only 34.5% having been trained-including training on respirator use [39]. Notably, cough etiquette had a role in TB IPC with a score of 80.2%.

Respondent 2 indicated that:

"*….We are afraid of acquiring TB in our line of duty. This is because there are no compensation strategies adopted in the hospital. Additionally, discrimination is on the rise in the workstation and most of the HCWs with TB have no special treatment that guarantees their privacy. After treatment, HCWs are returned to their high-risk areas instead of transfer to other safer environments. In most cases, this is because no HCW is willing to be assigned to those risk areas. In the hospital, we have developed a training schedule for all staff working in risky areas. However, we face a challenge of non-attendance because of various reasons including change of shift, sick-off and inadequate staff in our working areas. There are many beliefs about TB. Most of our patients usually indicate that TB is a bad omen for the families or a curse. They opt for traditional herbs as a mode of treatment instead of visiting hospitals. Other officers complain about how uncomfortable the respirators are since they are not in line with the specifications for the risk areas. We are therefore at a higher risk of getting infected than any other worker in the hospital …*"

The attitude level was reported at 72% (good) with most respondents indicating that they had a higher risk of acquiring the infection and although they knew about the disease, they expressed concern about being infected while in the line of duty. These findings are similar to a study conducted in Nepal among HCWs which showed that a considerable proportion of study respondents (73.2%) had a positive attitude toward compliance with TB IC guidelines despite having a poor level of knowledge with a score of 45.8%. This was contributed to the fact that sometimes the respirators among them were limited. Further, the study showed that more than half of the majority that participated had a concern about being infected with TB due to inadequate knowledge, limited respirators available and lack of triage of TB suspects [40]. The results were in agreement with a study done in Northwest Ethiopia which revealed that the respondents who had previously been trained on TB IPC were more knowledgeable than the untrained and thus were more likely to have good TB IPC practices [41]. The findings agree with a study carried out on the user acceptance of reusable respirators in health care which showed that the HCWs preferred N95 masks to reusable ones due to discomfort among others [42].

The majority of the respondents expressed the need to undergo TB screening especially those who were exposed to TB patients. In addition, there was no policy on TB screening and HCWs did it at their own discretion. Moreover, HIV testing and treatment were also voluntary. This was consistent with research conducted in Malawi which revealed that most facilities did not have a policy for regular screening for TB and that only a handful of HCWs had TB screening in the last year [43].

In conclusion, only a few HCWs were willing to be screened and treated due to a lack of privacy which resulted in stigma among their colleagues and also the community around them [44]. A similar study showed that stigma plays a role in delayed diagnosis, poor treatment outcomes and impaired well-being in HCWs who develop TB [44,45].

6. Conclusion

The study revealed a dire need to develop and implement a robust occupational health management system that takes cognizance of development and adherence to sensitization framework; accurate and prompt surveillance and reporting of TB; supportive legal framework; committed leadership; financial investment and strict/stringent measures in place to ensure compliance to set guidelines.

Acknowledgments

First and foremost, I would like to thank God Almighty for giving me good health, a source of knowledge and wisdom through which the completion of this thesis was enhanced.

My sincere gratitude goes to my supervisors, Dr. Washington Arodi and Dr. Emmah Mwangi for their generous contributions, positive criticisms, advice and commitment to guiding me through the entire process of developing this thesis.

Special appreciation goes to Kenyatta University, the School of Public Health and Applied Human Sciences and the Department of Environmental and Occupation Health, especially my lecturers for their maximum cooperation, extra devotion and help to successfully undertake this course.

I am also thankful for the invaluable input and cooperation of the management of both Kenyatta National Hospital and Mbagathi District Hospital and Health Care Workers for their willingness to participate in this study.

Lastly, I am greatly indebted to my family, friends and relatives for their financial, moral and spiritual support without which this work could not have been a success.

God bless you all.

References

[1] National Tuberculosis Leprosy and Lung Disease Unit - Ministry of Health, "Guidelines for TB infection Prevention and Control for Health Care workers in Kenya," no. July, pp. 1-71, 2014.

[2] I. Baussano, P. Nunn, B. Williams, E. Pivetta, M. Bugiani, and F. Scano, "Tuberculosis among health care workers," *Emerg. Infect. Dis.*, vol. 17, no. 3, pp. 488-494, 2011.

[3] M. Gjergji, J. Bushati, A. Harxhi, and H. Hafizi, "iMedPub Journals Tuberculosis in HIV / AIDS Patients Abstract Abbreviations : Introduction," pp. 1-7, 2017.

[4] A. T. Fojo and D. W. Dowdy, "Multidrug-resistant tuberculosis in India: looking back, thinking ahead," *Lancet Public Heal.*, vol. 2, no. 1, pp. e8-e9, 2017.

[5] J. Agaya *et al.*, "Tuberculosis and latent tuberculosis infection among healthcare workers in Kisumu, Kenya," *Trop. Med. Int. Heal.*, vol. 20, no. 12, pp. 1797-1804, 2015.

[6] M. Brouwer, E. Coelho, C. D. Mosse, and F. Van Leth, "tb ipc Mozambique ," vol. 19, no. August 2014, pp. 44-49, 2015.

[7] M. Engelbrecht, A. Janse van Rensburg, G. Kigozi, and H. C. J. D. van Rensburg, "Factors associated with good TB infection control practices among primary healthcare workers in the Free State Province, South Africa," *BMC Infect. Dis.*, vol. 16, no. 1, Nov. 2016.

[8] L. Uden, E. Barber, N. Ford, and G. S. Cooke, "Risk of Tuberculosis Infection and Disease for Health Care Workers: An Updated Meta-Analysis," *Open Forum Infect. Dis.*, vol. 4, no. 3, pp. 1-7, 2017.

[9] E. W. Kanyina, W. G. Boru, G. M. Mucheru, S. A. Amwayi, and T. Galgalo, "Tuberculosis infection among health care workers: a case series in two district hospitals, Kenya, August 2013," *Pan Afr. Med. J.*, vol. 28, no. August 2013, p. 4, 2017.

[10] C. Tudor *et al.*, "Occupational Risk Factors for Tuberculosis among Healthcare Workers in KwaZulu-Natal, South Africa," *Clin. Infect. Dis.*, vol. 62, no. Suppl 3, pp. S255-S261, 2016.

[11] A. Zumla, A. George, and V. Sharma, "WHO's 2013 global report on tuberculosis: Successes, threats, and opportunities," *Lancet*, vol. 382, no. 9907, pp. 1765-1767, 2013.

[12] D. Menzies, R. Joshi, and M. Pai, "Risk of tuberculosis infection and disease associated with work in health care settings [State of the Art Series. Occupational lung disease in high-and low-income," *Int. J. …*, vol. 11, no. 6, pp. 593-605, 2007.

[13] E. W. Kanyina, W. G. Boru, G. M. Mucheru, S. A. Amwayi, and T. Galgalo, "Tuberculosis infection among health care workers: a case series in two district hospitals, Kenya, August 2013," *Pan Afr. Med. J.*, vol. 28, no. August 2013, p. 4, 2017.

[14] L. D. Saraswati, P. Ginandjar, B. Widjanarko, and R. A. Puspitasari, "Epidemiology of Child Tuberculosis (A Cross-Sectional Study at Pulmonary Health Center Semarang City, Indonesia)," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 116, no. 1, 2018.

[15] J. J. Dunn, J. R. Starke, and P. A. Revell, "Laboratory diagnosis of mycobacterium tuberculosis infection and disease in children," *J. Clin. Microbiol.*, vol. 54, no. 6, pp. 1434-1441, 2016.

[16] T. G. T. Mba and T. G. Tshitangano, "Measures practised by healthcare workers to prevent tuberculosis transmission at rural hospitals in Vhembe District," *South. African J. Epidemiol. Infect.*, vol. 29, no. 2, pp. 65-69, 2014.

[17] R. Joshi, A. L. Reingold, D. Menzies, and M. Pai, "Tuberculosis among health-care workers in low- and middle-income countries: A systematic review," *PLoS Med.*, vol. 3, no. 12, pp. 2376-2391, 2006.

[18] J. E. McGowan and H. M. Blumberg, "Inner-city tuberculosis in the USA," *J. Hosp. Infect.*, vol. 30, pp. 282-295, Jun. 1995.

[19] A. S. Fauci, "Multidrug-Resistant and Extensively Drug-Resistant Tuberculosis: The National Institute of Allergy and Infectious Diseases Research Agenda and Recommendations for Priority Research," *J. Infect. Dis.*, vol. 197, no. 11, pp. 1493-1498, 2008.

[20] World Health Organisation, "Ending the Tb Epidemic," pp. 2015-2016, 2016.

[21] M. S. Islam, A. A. Chughtai, and H. Seale, "Reflecting on the updates to the World Health Organisation 2019 Tuberculosis Infection Control Guidelines through the lens of a low-income/high TB burden country," *Journal of Infection and Public Health*. Elsevier Ltd, 2020.

[22] L. Mosissa, A. Kebede, T. Mindaye, M. Getahun, S. Tulu, and K. Desta, "External quality assessment of AFB smear microscopy performances and its associated factors in selected private health facilities in Addis Ababa, Ethiopia," *Pan Afr. Med. J.*, vol. 24, 2016.

[23] A. W. Wanyonyi, P. M. Wanjala, J. Githuku, E. Oyugi, and H. Kutima, "Supplement article Factors associated with interruption of tuberculosis treatment among patients in Nandi County , Kenya 2015," vol. 28, no. Supp 1, pp. 1-6, 2017.

[24] NIPC, "NATIONAL INFECTION CONTROL GUIDELINES 2016 Draft for Consultation," *Natl. Infect. Control*, 2016.

[25] WHO, *Guidelines on tuberculosis infection prevention and control 2019*, vol. 91, no. 5. 2019.

[26] D. O. F. Leprosy and L. Disease, "NATIONAL GUIDELINES ON MANAGEMENT OF TUBERCULOSIS IN CHILDREN Ministry of Health DIVISION OF LEPROSY, TUBERCULOSIS AND LUNG DISEASE," no. March, 2013.

[27] M. Chaitkin and J. Githinji, "Sustaining Effective Coverage for HIV, Tuberculosis, and Malaria in the Context of Transition in Kenya Final Report Prepared by Results for Development Institute at the request of the Global Fund ii," 2017.

[28] "LAWS OF KENYA The Occupational Safety and Health Act," vol. 2010, no. 2007, 2010.

[29] M. Engelbrecht *et al.*, "Waiting to inhale: Factors associated with healthcare workers' fears of occupationally-acquired tuberculosis (TB)," *BMC Infect. Dis.*, vol. 19, no. 1, pp. 1-7, 2019.

[30] A. R. Isara and A. Akpodiete, "Concerns about the knowledge and attitude of multidrug-resistant tuberculosis among health care workers and patients in Delta State, Nigeria," *Niger. J. Clin. Pract.*, vol. 18, no. 5, pp. 664-669, Sep. 2015.

[31] P. Narasimhan, J. Wood, C. R. Macintyre, and D. Mathai, "Risk factors for tuberculosis," *Pulm. Med.*, vol. 2013, 2013.

[32] C. A. Haley, "Prevention of Tuberculosis : TB Screening, Diagnosis of Latent Tuberculosis Infection and Preventive Therapy," 2013.

[33] J. Volmink and C. Murphy, "Pulmonary Tuberculosis," *Evidence-based Respir. Med.*, pp. 321-333, 2007.

[34] MoH, "Human Resources Strategy," *Heal. Sect. Hum. Resour. Strateg. 2014-2018*, pp. 1-22, 2014.

[35] T. Galgalo *et al.*, "Tuberculosis risk among staff of a large public hospital in Kenya," *Int. J. Tuberc. Lung Dis.*, vol. 12, no. 8, pp. 949-954, 2008.

[36] World Health Organization, "WHO Policy on TB Infection Control in Health-Care Facilities, Congregate Settings and Households," p. 40, 2009.

[37] K. Tamir, B. Wasie, and M. Azage, "Tuberculosis infection control practices and associated factors among health care workers in health centers of West Gojjam zone, Northwest Ethiopia: a cross-sectional study," *BMC Health Serv. Res.*, pp. 1-11, 2016.

[38] L. T. Bhebhe, C. Van Rooyen, and W. J. Steinberg, "Attitudes, knowledge and practices of healthcare workers regarding

occupational exposure of pulmonary tuberculosis," *African J. Prim. Heal. Care Fam. Med.*, vol. 6, no. 1, pp. 1-6, 2014.

[39] M. M. Malotle *et al.*, "Occupational tuberculosis in South Africa: are health care workers adequately protected?," *Public Heal. Action*, vol. 7, no. 4, pp. 258-267, Jan. 2018.

[40] A. Shrestha, D. Bhattarai, B. Thapa, P. Basel, and R. R. Wagle, "Health care workers' knowledge, attitudes and practices on tuberculosis infection control, Nepal," *BMC Infect. Dis.*, vol. 17, no. 1, pp. 1-7, 2017.

[41] T. Chanie and D. Meaza, "Knowledge and practice of tuberculosis infection control among health professionals in Northwest Ethiopia; 2011," *BMC Health Serv. Res.*, vol. 14, 2014.

[42] S. E. Hines *et al.*, "User acceptance of reusable respirators in health care," *Am. J. Infect. Control*, vol. 47, no. 6, pp. 648-655, 2019.

[43] R. J. Flick *et al.*, "Assessing infection control practices to protect health care workers and patients in Malawi from nosocomial transmission of Mycobacterium tuberculosis," *PLoS One*, vol. 12, no. 12, pp. 1-13, 2017.

[44] A. von Delft *et al.*, "Why healthcare workers are sick of TB," *Int. J. Infect. Dis.*, vol. 32, pp. 147-151, 2015.

[45] R. R. Nathavitharana *et al.*, "Agents of change: The role of healthcare workers in the prevention of nosocomial and occupational tuberculosis," *Presse Medicale*, vol. 46, no. 2. Elsevier Masson SAS, pp. e53-e62, Mar. 01, 2017.