American Journal of Public Health Research, 2023, Vol. 11, No. 3, 88-98
Available online at http://pubs.sciepub.com/ajphr/11/3/2
Published by Science and Education Publishing
DOI:10.12691/ajphr-11-3-2

Compliance with Tuberculosis Infection, Prevention and Control Guidelines among Healthcare Workers in Kenyatta National Hospital and Mbagathi District Hospital

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Received March 12, 2023; Revised April 17, 2023; Accepted April 26, 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 profession 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 tb cases were associated to poor implementation of full hierarchy of IPCs as outlined by the World Health Organization (WHO) especially the administrative control. This study was cross sectional study which was conducted in Kenyatta National Hospital and Mbagathi District Hospital, Nairobi County. **Objective:** The study sought to determine the influence of socio-demographic factors on compliance to TB IPC guidelines among HCWs 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 interview (KII) and standardized observation checklist 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 questionnaire, interview schedule, 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 Microsoft Excel programme to generate frequency tables, graphs and pie-charts. Inferential statistics was calculated using Chi-Square tests (p=0.005) done at 95% confidence level to determine the linkage between the Variables. **Results:** There was no statistically significant association between marital status and compliance to TB-IPC guidelines (P=0.067) with the divorced more likely to comply with TB-IPC standards (OR=3.6, CI: 0.504, 25.323). The study findings further revealed that majority 171 (59.6%) of participants had a fair attitude and comply to TB-IPC guidelines (P=0.034). 245(61.6%) have a work experience of less than 2 years, followed by 142(35.7%) having worked three to five years with 11(2.8%) having worked over 5 years. There was a statistical association between the number of years worked and compliance to TB-IPC guidelines. 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). **Conclusion**: 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, "Compliance with Tuberculosis Infection, Prevention and Control Guidelines among Healthcare Workers in Kenyatta National Hospital and Mbagathi District Hospital." *American Journal of Public Health Research*, vol. 11, no. 3 (2023): 88-98. doi: 10.12691/ajphr-11-3-2.

1. Introduction

Tuberculosis (TB) as commonly referred as, 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 a far. 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 or 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 confirmatory test for pulmonary TB [2]. Some of the TB risk factors include malnutrition, pregnancy, cigarrete smoking alcohol consumption and chronic infections like cancer and diabetes mellitus [3].

In healthy adults exposed, only 5-10% develops the disease in their lifetime, mostly within the first and second year of exposure. According to WHO report in 2013 October, a third of world's total population had the disease with 9million getting infected annually hence causing 2million 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 significance increases in morbidity and mortality cases. For instance in 2015, 10.4million got the disease, 1.2million (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 sero-positive [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 of this public health menace yet this measure is cost-effective and also very attainable at any given healthcare facility [7]. From the research conducted, the most facilities were congested; those coughing "TB suspects" had no separate waiting areas, no tissue or surgical masks offered to suspects with inadequate ventilation in high-risk areas like waiting bays, medical wards, TB wards and Laboratory area. The HCWs job cadre most regarded as the high risk group includes the professional nurses, laboratory staff, nursing and medical students [8,9].

However, all the HCWs are in the 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 region. 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 of TB IPC in a healthcare set-up that, administrative, environmental and personal respiratory protective measure (PRP) supported by the managerial team is seen as the remedy to occupational tb [12]. This has shown to reduce the incidence of TB by 27%-81% based on the country's burden [9].

2. Literature Review

2.1. Introduction

Mycobacterium tuberculosis is an obligate pathogenic bacterium under the family of Mycobacteriaceae. It is 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 [13]. 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 on individual's level of immunocompetence. Therefore, the 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 the 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 [14].

Infection, Prevention and Control (IPC) measures are guidelines and policies that have been recommended by both the WHO and IUTLD in health care facilities in regard to nosocomial Tuberculosis among the Healthcare workers as well as the 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 significance increase noted on those who had a longer exposure in isolation rooms and longer duration of

employment. According to NLTD report, the duration of exposure, proximity with 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 to 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 in prevention of TB transmission in healthcare setting [15].

In the High-Income Countries, the following are the main strategies established in prevention of the disease on 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 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 [16]. Tuberculosis however, is seen as a major occupational hazard among healthcare workers, not just as a nation but globally due to consistent and routinely occupational exposure [8]. This is especially true among the nurses and laboratory workers among the profession cadre who are regarded as high-risk groups for both Latent Tuberculosis Infection (LTBI) as well as active TB, with the lowest risk was noted among the administrative staff. This was confirmed by a research carried out in Kenya between 2010 and 2013 in both Makindu and Kiambu District hospital [9]. Another category that seemed to be affected is both medical and nursing students [2].

In a study done in Kigali Rwanda, HCWs 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 high number of admissions with TB patient posed a higher risk of transmission with annual risk of TB infection (ARTI) going as high as 11.3% with an exception to pediatric ward. In studies conducted in Russia and South Africa, the TB disease was higher among the Healthcare workers than the general population with attributable risk ranging 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 to implementation of full hierarchy of IPCs as outlined by WHO [16]. Co-morbidity with HIV/AIDS has escalated the TB disease with risk per annum being at 10% among sero-positive persons compared to 10% risk in healthy individuals in a life time [7,10].

The fact that most hospitals provide both HIV and TB treatments/services co-currently, the risk of TB infection among the sero-positive 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, 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 the 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 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. The MDR-TB is commonly due to non-compliance on patients as well as incomplete of anti-TB therapy among less privileged like the immigrants and the homeless [17]. 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 Oct, 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 [11,18].

However, on 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 on 2012, the 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 sero positive. By 2016, 49 million lives were saved and a remarkable 22% drop in mortality cases, between year 2000 and 2015 [10,19].

It was also noted that approximately 3million people were not included in the report issued either because they were either not diagnosed or were actually diagnosed but never reported. Moreover, a fifth of MDR cases were detected but not treated, this poses as a greater threat in spreading of MDR TB in both at regional and global level hence a dire need for United States $ 2Billion 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]. On 2015, a global TB strategy framework was put to place that would run through 2025 and with introduction of new vaccines and effective treatment for LTBI persons, would achieve Sustainable Development Goals (SDG) 2030 and end TB pandemic by 2035. To achieve the target that included;

reduction of deaths by 75% and TB incidences by 50% as well as death reduction by 95% with 90% incidence rate in year 2025 and 2035 respectively, three pillars and components were put in place. The pillars include; provision of integrated patient-control and prevention; establishment and integration of bold policies and support systems and finally carry out intensified research and innovations [19].

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 [20]. 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 [21]. 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 [22]. The incidence of TB is 10times more than it was in since its emergence in 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 [23].

WHO estimated that the TB prevalence rate in Kenya was 70% by 2007, representing strictly the cases that were diagnosed and treated accordingly [24]. 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 sero-positive [25]. In 2017, the government of Kenya had projected a national Tuberculosis budget of US $62 million with 41% fund 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 report released by the National Tuberculosis, Leprosy and Lung Disease division (NTLD), the household prevalence survey as at 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 Multi drug resistance among the infected [26]. 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 [27].

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 in 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 hospitalised for drug-resistant TB (DRTB) than the population they care for [28].

2.4. Socio-demographic Factors Associated with TB

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 plays a key role in acquiring the disease. The risk of progression from exposure to the tuberculosis bacilli to the development of active disease is a two stage process governed by both Exogenous factors and endogenous risk factors [29].

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 transplant (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 lifestyle like tobacco smoking and alcohol dependency; pregnancy as well as in persons who had previously undergone TB treatment [30].

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 [31].

The socio-economic 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 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 lungs leaving it highly susceptible to developing TB from a dormant LTBI [32].

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 sero-positive and attributed to one-third of total mortality cases among the AIDS Tuberculosis. It is evident that the death of the co-morbid persons is twice higher compared to sero-positives without active TB. Moreover, the sero-positive persons have thirty times greater risk of contracting TB than the sero-negative 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 high TB burden and according to the Ministry of Health (MoH) report in 2012, Nairobi led in TB prevalence totaling to 20,102 cases with 6.3% of total deaths in Kenya and contributing to 4.8% of total Disability Adjusted Life Years (DALYs) [33] and [1]. Furthermore, a study carried in 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 [34]. Poor implementation of IPCs has not only steadily increased the occupational tb among the 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 the research done on 2011 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 rate 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 [2,35]. Tuberculosis among the LMICs is contributed majorly by occupation exposure with prevalence of 63% (with a range of 33-79%) in HCWs while in HICs, TB was due to no-occupational factors with 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 [19].

3. Materials and Methods

3.1. Study Design

The study employed descriptive cross-sectional design to access the compliance to TB IPC guidelines among HCWs in Kenyatta National Hospital and Mbagathi District Hospital. Descriptive research depicts the characteristic of the phenomenon/population being studied at 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 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 which 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 of nurses and the laboratory staff-technicians and technologist 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 to 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 their accessibly, affordability and quality services. Since there are several cadres of HCWs in hospital setting, each cadre was treated as a stratum. The cadre (Nurses and Laboratory staff) were purposely selected on 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 of nurses and the laboratory staff-technicians and technologist 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 to 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 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 for non-responses the researcher added 10% of the sample size, totaling to 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, ensuring 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 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, observation checklist was utilized to observe the HCWs behavior's/ practices at 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 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 variable. This was done at 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 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 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 was free to withdraw from the interview at any point. They were given 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. Socio-Demographic Characteristics of Respondents

According to the study, majority of the respondents 150 (37.7%) were aged between 20 to 29 years, followed by 141 (35.4%) aged between 30 to 39 years. Most of the participants were females 215 (54%) with 183 (46%) males. Slightly over half of the respondents were married 222(56.6%) followed by 150(38.3%) singles. Notably, 173(43.6%) were diploma holders followed by Bachelor's degree holders 121 (30.5%). Further, the study revealed that 245 (61.6%) have worked less than two years and 142(35.7%) three to five years. Regarding hours per shift 279 (70.1%) indicated that shift hours range from 8 to 10, followed by 96(24.1%) less than 8 hours. Majority of the respondents 330(82.9%) have not been attended do not hold continuous medical education with 17.1% (n=68) stating otherwise. Most 157(39.4%) earn Kshs 50,001 to 100,000, followed by 34.2% (n=136) earning Kshs 30,001 to 50,000. Slightly above half of the participants 207 (52%) had received TB training in the last six months.

The results were presented in Table 2 below:

Table 2. Socio-demographic characteristics of the respondents

	Variable	Frequency (n)	Percent (%)
Age (years) Mean ± SD	20 to 29	150	37.7
	30 to 39	141	35.4
	40 to 49	84	21.1
	Over 50	23	5.8
Gender	Male	183	46
	Female	215	54
Marital status	Single	150	38.3
	Married	222	56.6
	Divorced	6	1.5
	Widowed	9	2.3
	Separated	5	1.3
Level of education	Certificate	13	3.3
	Diploma	173	43.6
	Higher Diploma	73	18.4
	Bachelors	121	30.5
	Masters	17	4.3
Number of years worked in years	Less than 2	245	61.6
	3 to 5	142	35.7
	Above 5	11	2.8
Hours per shift (hrs)	Less than 8	96	24.1
	8 to 10	279	70.1
	11 to 12	15	3.8
	Over 12	8	2.0
Continuous medical education	Yes	68	17.1
	No	330	82.9
Frequency of medical education	2 to 3 times a week	25	36.8
	2 to 3 times a month	41	60.3
	Yearly	2	2.9
Salary received per month	<Kshs 30,000	27	6.8
	Kshs 30,001-50,000	136	34.2
	Kshs 50,001-100,000	157	39.4
	Above Kshs100,000	40	15.6
	Not applicable	16	4.0
TB training in the last 6 months	Yes	207	52.0
	No	191	48.0

4.2. Compliance to 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 [36] which revealed that among 662 HCWs, only a third had proper overall TBIC practices.

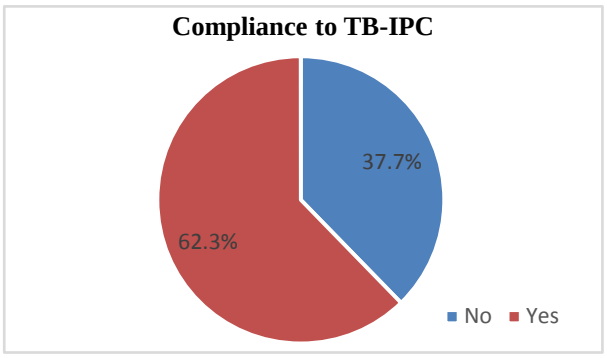

Figure 1. Compliance to TB-IPC

4.3. Association between Socio-demographic Characteristics and TB-IPC Compliance among the Study Respondents

The study sought to determine the respondent socio-demographic characteristics. According to the research, majority of the study participants were aged between 20 to 29 years with no statistical association between age in years and compliance to TB-IPC (P=0.210). The strength of association was reported as 6.1 times more likely (CI: 1.6,23.5) for age 30 to 39 years to comply with the TB-IPC as compared to other categories. the study population comprised of 215(54%) females and 183 (46%) males. There was no significant relationship between the participant gender and compliance to TB-IPC guidelines (P=0.302). Females are less likely to comply with TB-IPC guidelines compared to males (OR=0.64 CI: 0.4, 1.032). In responding to marital status, findings revealed that most of the respondents 222 (56.6%) were married, followed by 150 (38.3%) single, 9(2.3%) widowed, 6(1.5%) divorced and 5(1.3%) separated. There was no statistically significant association between marital status and compliance to TB-IPC guidelines (P=0.067) with the divorced more likely to comply with TB-IPC standards (OR=3.6, CI: 0.504, 25.323). Almost half of the participants 173(43.6%) of them were Diploma holders, 121(30.5%) Bachelors, 73(18.4%) Higher Diploma, 17(4.3%) master's degree holders and 13(3.3%) stating their highest level of education as Certificate. There was no statistical association between the level of education and compliance to TB-IPC guidelines with higher diploma more likely to adhere to TB-IPC guidelines (OR=1.789, CI: 0475, 6.729). Notably, 245(61.6%) have a work experience of less than 2 years, followed by 142(35.7%) having worked three to five years with 11(2.8%) having worked over 5 years. There was a statistical association between the number of years worked and compliance to TB-IPC guidelines.

Concerning the number of hours per shift majority respondents revealed that 279(70.1%) a shift ranges from 8 to 10 hours, followed by 96(24.1%) taking less than 8 hours, 15(3.8%) 11 to 12 hours with 8(2%) taking over 12 hours. There was however no statistical significance between the hours per shift and compliance to TB-IPC guidelines, Notably, respondents working over twelve hours were 3.862 times more likely to comply compared to other reported working shifts (CI: 1.014,14.714). Over three quarters of the respondents 330(82.9%) indicate that they do not hold continuous medical education with 68(17.1%) stating otherwise. There was no statistical association between Continuous medical education and compliance to TB-IPC guidelines. However, those no CMEs are more likely to comply with the TB_IPC guidelines (OR: 1.670, CI: 0.8, 3.486).

According to the study findings, 157(39.4%) earn Kshs 50,001 to 100,000, followed by 136(34.2%) earning Kshs 30,001 to 50,000 with 16(4.0%) not paid for the services they provide. They were either students or voluntary staff. There was a statistically significant relationship between participant salary per month and compliance to TB-IPC guidelines. Prior to the study, 207(52.0%) of the respondents had received training on TB and TB related topics with 191 (48.0%) stating otherwise. There was no statistically significant association between Training on TBIPC and compliance to TB-IPC guidelines. The results were presented in Table 3 below:

Table 3. Association between socio-demographic characteristics and TB-IPC compliance among the study respondents

Variable	Respondent response	Dependent variable (Compliance to TB-IPC guidelines)				Statistical significance	OR (95% C.I)
		Yes		No			
Age (years) Mean ± SD	20 to 29	32.0% (48)		68.0% (102)		X^2=4.526, P-Value=0.210, Df=4	1
	30 to 39	44.0% (62)		56.0% (79)			6.1 (1.6, 23.5)
	40 to 49	38.1% (32)		61.9% (52)			1.2 (0.4, 3.6)
	Over 50	34.8% (8)		65.2% (15)			1(0.3, 2.9)
Gender	Male	40.0%	86	60.0%	129	X^2=1.064, P-Value=0.302, Df=4	1
	Female	35.0%	64	65.0%	119		0.64 (0.4, 1.032)
Marital status	Single	40.7%	61	59.3%	89	X^2=8.776, P-Value=0.067 Df=4	1
	Married	33.3%	74	66.7%	148		1.9 (0.267, 14.596)
	Divorced	66.7%	4	33.3%	2		3.6(0.504, 25.323)
	Widowed	66.7%	6	33.3%	3		1.1(0.070, 15.549)
	Separated	60.0%	3	40.0%	2		0.9(0.074, 9.965)
Level of education	Certificate	69.2%	9	30.8%	4	X^2=6.192, P-Value=0.185 Df=4	1
	Diploma	35.3%	61	64.7%	112		0.656 (0.105, 4.102)
	Higher Diploma	35.6%	26	64.4%	47		1.789 (0.475, 6.729)
	Bachelors	38.8%	47	61.2%	74		1.728 (0.447,6.682)
	Masters	35.3%	6	64.7%	11		1.190 (0.323, 4.384)
Number of years worked in years	Less than 2	47.9%	46	52.1%	50	X^2=6.284, P-Value=0.043 Df=4	1
	3 to 5	37.6%	56	62.4%	93		0.249 (0.106, 0.582)
	Above 5	32.0%	47	68.0%	100		0.516 (0.269, 0.990)
Hours per shift (hrs)	Less than 8	50.0%	2	50.0%	2	X^2=10.229, P-Value=0.249 Df=3	1
	8 to 10	36.7%	33	63.3%	57		2 (0.082, 48.502)
	11 to 12	36.5%	104	63.5%	181		3.54(0.855, 14.649)
	Over 12	57.9%	11	42.1%	8		3.862 (1.014, 14.714)
Continuous medical education	Yes	27.9%	19	72.1%	49	X^2=3.318, P-Value=0.069 Df=1	1
	No	39.7%	131	60.3%	199		1.670 (0.8, 3.486)
Salary received per month	<Kshs 30,000	59.3%	16	40.7%	11	X^2=13.981, P-Value=0.003 Df=3	1
	Kshs 30,001-50,000	46.3%	63	53.7%	73		0.176 (0.047, 0.655)
	Kshs 50,001-100,000	31.2%	49	68.8%	108		0.348 (0.131, 0.923)
	Above Kshs100,000	27.5%	11	72.5%	29		0.713 (0.285,1.779)
	Not applicable						0.176(0.047, 0.655)
Training on TBIPC	Yes	76	36.7%	131	63.3%	X^2=0.242, P-Value=0.623 Df=1	1
	No	72	39.1%	112	60.9%		0.896 (0.539, 1.491)

5. Discussion

5.1. Socio-demographic Factors

The study revealed that majority of the study participants were aged between 20 to 29 years accounting for 37.7% (150) of the total study population. This is a clear indicator that most of the study participants in the health setup are young. Further, to this, most of these are diploma holders (43.6%) which is the entry point for health care workers at the two referral hospitals. The study findings are in line with a study conducted by [37] on Knowledge, practices and associated factors of IP among HCWs which revealed that most of the healthcare workers working in the referral hospital were young aged below 30 years (55.7%) with nearly half of the subject respondents (47%) being diploma holders. However, A study by [38] among HCWs during Covid-19 pandemic in Singapore is inconsistent with this findings which revealed that most HCWs who participated in the research had a college degree and above level of education (69.3%).

According to the data analysis, most of the study participants were females. This contributes to 54% of the total study participants. A similar study by [39] on Sex and Gender in HCWSs in conflict settings in United States of America revealed that most of the healthcare workers in health and social work labor markets were predominantly females with males often in pharmacy, medicine and dentistry positions while females often in nursing and midwifery jobs. Further, according to Kenya Nursing Workforce Report [40] majority of the qualified and registered nurses with National Council Of Kenya (73.6%) are female in gender. Moreover, it was revealed that 77% of nurses were females due to fewer male nurses being employed (Kenya Health Workforce [41]. In fact, men are under-represented in nursing due to nursing perceived of being a female oriented profession and lack of male role models according to a study done in Canada [42]. According to an analysis of 104 countries conducted by the World Health Organization, approximately 70% of the global health-care workforce is made up of women [43]. Women therefore have been described as the drivers of global health. In line with these and other various researches, it can be concluded that the healthcare environment is more likely to attract females than males because the former concentrate more into lower status, lower pay, unpaid roles and are more willing to bear with harsh conditions.

The researcher further sought to find out the participant number of years worked in the facility. Findings revealed

that 61.6% had worked for less than two years, followed by 35.7% indicating three to five years. The study findings are inconsistent with a study conducted by [44] among nurses (n= 379) in Moi and Teaching Referral Hospital, Eldoret which showed that majority of HCWs had worked between 6-10 years. Further, [45] a research conducted on the implementation of infection controls in Arua district health facilities in Uganda found out that, most of the HCWs in those health facilities had worked for over 11 years (n=202). Further, according to Kenya Nursing Workforce Report [40], HCWs working in highly specialized areas required extra years to specialize , for example, in critical care, pre-operative, psychiatry and pediatric among others. The upgrading of education observed among the nurses in Kenya included either horizontal (a second or a specialty at the same level) or vertical upgrade (next level of educational training).

Regarding the hours per shift that HCWs spent while offering services at various service points, the study revealed that over two thirds (70.1%) of the study participants spent between 8 to 10 hours. High number of working hours against the recommended 8 hours per shift can be attributed to increased number of patients seeking medical attention at the hospitals and upsurge in patients seeking specialized services. Notably, in the referral hospitals, manual systems are being used thus leading to increased waiting times thus a HCW requires to clears all scheduled patients before handover. In addition, a research carried out in Kenya Public hospitals among neonatal wards showed that the nursing team was understaffed with significant pressure to bridge the gap between international standards of nursing and the circumstances daily and that not only did most work long hours without supervision but that the wards were ill-designed [46]. According to a research carried out on Workplace Health and Safety research among the hospital nurses [47] it was evident that there exists no national standard or shift length for nurses globally and as a result, most end up working upto 8.5hours or 12.5 hours with many required to work overtime. This ultimately, has greatly contributed to nurse fatigue and emotional stress hence patients' accidents and injuries and dissatisfactory services.

Concerning continuous medical education, 82.9% had not attended any CME in the course of duty. Further, 60.3% of the HCWs had been trained 2 to 3 times a month with 52% reporting to have undergone TB training for the last six months. CMEs is a recommended exercise that is critical for HCWs so as to keep on upgrading medical skills. This goes a long way to enhancing the quality of care while improving clinical outcomes. A research conducted on Continued Nursing Education among the LMICs [48] highlighted the importance of CMEs among HCWs as this is essential and effective tool in improving knowledge base and thus patient outcomes and quality of care. The study emphasized on training key focus areas such as hand washing, infectious diseases, TB management, Patient management, Palliative care, Laboratory and Diagnostic Services etc. The CMEs provide a platform for HCWs to air their concerns as raised by the patients and individual experiences as they offer services. Various researchers such as [49] have emphasized the need for interactive online CMEs compared to Traditional CMEs due to its flexibility of time and place. According to some states, mandate CME for relicensure required 12-50 hours per year for every HCW. Adequate training, job security, salary, supervisor support, and manageable workload were identified as critical satisfaction factors. This was in consistent with a study conducted on HCWs in LMICs by [50] that further showed that combined and multifaceted training interventions could help improve knowledge, skills and competence.

According to the study, 39.4% of the respondents revealed that salary received per month was reported as Kshs. 50,001 to 100,000. The results concur with a study done on 170 HCWs in two different states (Ondo and Nasarawa states) [51] which revealed that the estimated monthly salary for healthcare workers in a Hospital setup ranged between USD800 to USD1,000. Further, stated that the salary plays a major role in employee commitment to offer services since it motivates them though for a short period. It also enables workers to commit to deliver on their mandate without aiming at any service disruption that may hinder or jeopardize commitment to offer services. A better salary is critical in ensuring employees remain within a specific hospital thus gaining more skills and understanding better mechanism of problem solving and creating sense of belonging. In addition, a study carried out in Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH) [52] on Compensation Management Practices and Quality Healthcare revealed that adopting incentive system (both monetary and non-monetary rewards) enhances employees' motivation, attachment to the organization and ensures optimal levels of performance of the HCWs.

One of the department-in-charge who was in the key informant interview session reported that;

"…..…There are scheduled monthly CMEs aimed at enhancing skill capacity of various members of staff. The CMEs help in equipping various HCWs with prerequisite skills such as patient management, customer centric, infectious management, handwashing, nosocomial related matters. Further, we conduct random spot checks aimed at testing real time compliance to set TB-IPC standards. The checks help in determining the compliance levels of various functional sections of operation…."

Another participant reiterated that:

"…. *We conduct TB trainings at least two to three times in a month. The responsible department distributes IEC materials and other presentations after the training for reference purposes. However, attendance is usually low due to increased staff workload, various staff are away because of changes in shifts, fatigue or getting tired after the night shift and absence from the training since some are manning the stations to offer any urgent support to patients. Due to the emergence of Covid-19 disease, the number of staff released to attend the TB trainings has gone down as a result of reduction in number of staff trained per session…."*

6. Conclusion

The results revealed that most of the respondents complied with the laid down TB IPC guidelines. However,

based on observations the hospital environment in which this study was conducted does not depict the scoring. It is therefore imperative that the identified gap be addressed such as understaffing, increased workload, inadequate training so as to enhance service delivery and reduce the likelihood of contracting TB at various work points.

Acknowledgements

First and foremost, I would like to thank God Almighty for giving me good health, 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 in guiding me through the entire process of developing this thesis.

Special appreciation goes to Kenyatta University, School of Public Health and Applied Human Sciences and 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 managements 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.

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