COMPLIANCE WITH TUBERCULOSIS INFECTION, PREVENTION AND CONTROL GUIDELINES AMONG HEALTHCARE WORKERS IN KIBERA, NAIROBI CITY COUNTY, KENYA.

JANEFFER MUTHONI WANGARI (BSC. MLS)
Q22/CTY/PT/37404/2017

A THESIS SUBMITTED IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS OF THE AWARD OF THE DEGREE OF MASTERS OF SCIENCE (OCCUPATIONAL HEALTH AND SAFETY) IN THE SCHOOL OF HUMAN SCIENCES OF KENYATTA UNIVERSITY

APRIL, 2024

DECLARATION

ii

DECLARATION

This thesis is my original work and has not been presented for a degree in any other university or for any other award.

Signature..... Date 26/04/2024

Janeffer Muthoni Wangari; Q22/CTY/PT/37404/2017
Department of Environmental and Occupational Health

SUPERVISORS

We confirm that the work reported in this thesis was carried out by the candidate under our supervision.

Signature..... Date 05/05/24

Dr. Emmah Mwangi
Department of Environmental and Occupational Health
Kenyatta University

Signature..... Date 02/05/2024

Dr. Washington Arodi
Department of Medical Laboratory Sciences
Kenyatta University

DEDICATION

This thesis is dedicated to my family for their financial support, prayers, precious time, and motivational words. Special thanks to Joseph Martin Ririani, Beatrice Wangari and Sosten Kemboi Kogo.

ACKNOWLEDGEMENTS

I would like to foremost thank the Almighty God for this far He has helped me to even successful complete this thesis.

Secondly, I would like to express my sincere gratitude to my supervisors, Dr Washington Arodi and Dr Emmah Mwangi for their generous contributions toward developing this thesis. Your advice, criticism and commitment made my work better each time. Thank you Dr. Warutere for your input on the work to ensure that the paper was more of an occupational Safety & Health than a Public Health study.

My precious friends Angela Wangari and Francis Githua and my colleagues James Gitau, Morgan Mbugua and John Kimeu, you are such an amazing lot, God bless you for me.

Finally, my appreciation goes to my beloved family, relatives and friends who genuinely sacrificed their finances and time to ensure this paper is finalized. Moreover, your moral and spiritual support cannot go un-recognized.

May the good Lord bless you according to the measure of your faithfulness.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS/ACRONYMS

AFB	Acid Fast Bacilli
AIDS	Acquired Immunodeficiency Syndrome
ARTI	Annual risk of TB infection
BCG	Bacille-Calmette Guerin
CDC	Center for Disease Control and Prevention
CRF	Chronic Renal Failure
DALYS	Disability adjusted life years
DFID	Department for International Development
DM	Diabetes Mellitus
DST	Drug Susceptibility Testing
HCWs	Healthcare Workers
HEPA	High Efficiency Particulate Air
HICs	High income countries
HIV	Human Immunodeficiency Virus
IGRA	Interferon Gamma Release Assay
IPC	Infection, Prevention and Control
IUTLD	International Union of Tuberculosis and Lung Disease
LMICs	Low and medium income countries
LTBI	Latent Tuberculosis Infection
MDRTB	Multidrug-Resistant Tuberculosis
MTB	Mycobacterium Tuberculosis
MoH	Ministry Of Health
NACOSTI	National Commission for Science, Technology and Innovation

N95	Not Resistant to Oil; Filters 95% of Airborne Particles
NRA	Nitrate Reductase Assay
NTLD	National Tuberculosis, Leprosy and Lung disease
NTM	Non-Tuberculous Mycobacterium
OSHA	Occupational Safety & Health Act
PBN	p- Nitrobenzoate
PCR	Polymerase Chain Reaction
PLWHA	People Living With HIV/AIDS
PPE	Personal Protective Equipment
PRP	Personal respiratory protection
RIF	Rifampicin
RNA	Ribonucleic Acid
SDGs	Sustainable Development Goals
SPSS	Statistical package for social sciences
TST	Tuberculin Skin Testing
TB	Tuberculosis
WHO	World Health Organization
XDR-TB	Extremely Drug Resistant Tuberculosis
Xpert MTB/RIF ASSAY	Nucleic Acid Amplification Technology

OPERATIONAL DEFINITIONS OF TERMS

Compliance: Is the observance or process of following rules, guidelines, regulations, state and federal laws that relate to particular practices.

Compensation: Refers to reimbursement or remuneration awarded to someone who suffers a loss, injury or fatality in line of duty.

Diagnosis: Medically this refers to a procedure of establishing or ascertaining which condition or disease one is suffering from by critically analyzing or cross examining their clinical manifestations or via conducting supportive tests.

Duty of care- Every occupier shall ensure the safety, health and welfare at work of all persons working in his workplace- Section 6(1) of OSHA 2007.

Epidemic: Refers to an outbreak of a disease that rapidly spread across the certain or given population or a community.

Health: Is a state of being complete physically, psychologically, emotionally, socially and spiritually. This however does not connote the absence of a disease or infirmity.

Health Care Workers: Are persons who help in the delivery of care and services to the ailing and can either do so directly in cases of doctors and nurses or indirectly as helpers or aides in cases of laboratory technicians, medical waste handlers among others with an aim of protecting and improving their health.

Hierarchy of control: is a concept used in industries to either eliminate or minimize (or can achieve both) exposure to hazards and includes the Elimination, Substitution, Administrative and Personal Protective Equipment.

Immunosuppression: This refers to inability to contend with diseases due to reduced or total failure of activation of the immune system.

Infection, Prevention and Controls (IPC): Is a scientific approach that offers practical solution in ensuring prevention of harm especially to those who are vulnerable to acquiring the infection both while receiving care at hospital or at the community level.

Microscopy: Is an act of investigating a minute object using an equipment referred to as a microscope by magnifying it to make it visible to human eyes.

Occupation: Refers to a job, profession, line of duty or employment.

Occupational Tuberculosis: Is a hospital acquired infection or an infection originating or taking place in a hospital and is transmitted by inhalation of droplet nuclei of the mycobacterium bacilli either between the patients or between the patients and the health care workers.

Pandemic: Refers to a break out of a disease that cannot be slowed down and therefore spreads to different regions of the globe.

Pathogen: Refers to a disease-causing agent in a host which includes bacteria and viruses.

Relapse: Refers to return of a disease or infection after a period of subsiding or improvement or partial recovery or sometimes after an apparent recovery.

Resistance: Refers to ability to successfully resist or withstand something. In reference to Tuberculosis, the bacilli develops insensitivity against effects of certain chemical agents/drugs whereas the majority of the bacteria are easily inhibited or killed.

Safety: Refers to a well-being; a state of being secure and free from danger or harm.

Transmission: Refers to a passage or transfers of an infectious pathogen from one individual to another or to a group of persons.

ABSTRACT

Tuberculosis is one of the major occupational hazards recorded among healthcare workers, not just in Kenya but globally due to their consistent and routine exposure. This is especially true among the nurses and laboratory workers who are regarded as high-risk groups for both Latent Tuberculosis Infection (LTBI) as well as active TB, among the profession cadre. From the studies done within Kenya and globally, it has been proved that the risk of infection among Health Care Workers (HCWs) compared to the general population is three times more with poor implementation administrative control cited as the major cause according to World Health Organization (WHO). The study was aimed at producing baseline data that would be used to create awareness on existing morbidity within the community hence lead to prevention and control measure being put in place. This too shall contribute significantly to the Sustainable Development Goal (SDG) indicator of 'End TB 2050'. The study sought to assess the compliance to TB IPC among HCWs in Kenyatta National Hospital and Mbagathi District Hospital. The study sample was 406 participants from KNH and Mbagathi hospitals. Out of the 406 questionnaires distributed, 98.0% (n=398) were completed, accurately filled and returned. A total of 36 nurses, 4 laboratory staff participated from Mbagathi with 328 nurses and 30 laboratory staff from KNH. Statistical Package for Social Sciences version 22.0 was used to analyze the descriptive statistics. Thematic analysis was employed to analyze qualitative data and triangulated with quantitative data either as narrations or direct quotes. The Chi-Square tests were done at 95% confidence interval and results with p-values of less than 0.05 ($p<0.05$) were considered significant. This helped identify the relationship between various variables. Moreover, Pearson's correlation too was done to show the strength of the association. The study findings revealed that the socio-demographic factors that significantly influenced respondents' compliance to the laid down TB IPC guidelines included the number of years worked (P=0.043) and salary received per month (P=0.003). Further, the HCWs generally had a high level of knowledge on TB with low score observed on TB prevention aspect. On compliance, the administrative aspect of control measure was noted as inadequate contrary to what was filled in the questionnaires. The study further revealed that those with a fair attitude were more likely to comply with TB IPC guidelines than their counterparts. Thus, knowledge and attitude levels were significantly associated with compliance to TB IPC guidelines (P=0.000). In conclusion, there is a dire need to offer continuous medical education to HCWs despite their tight schedules with an emphasis on TB prevention. Moreover, the hospitals managements should ensure that appropriate policies such as compensation policy, incentive program, TB screening and HIV/AIDS testing and treatment that is staff-friendly are formulated and implemented to boost the attitude of the HCWs.

CHAPTER ONE: INTRODUCTION

1.1 Background information

Tuberculosis (TB) is a bacterial infection caused by Mycobacterium bacilli. It is spread through inhalation of aerosols released by an infected untreated person via coughing, sneezing, laughing, talking or even singing (World Health Organitation, 2023). These aerosols can be transferred a far off while suspended in the air. In the lungs, the inhaled mycobacterium bacilli lounges into the alveoli where they are engulfed and degraded by the immune cells. When the bacilli nucleoli lounged is dormant, it forms a granuloma hence latent Tuberculosis infection. Alternatively, this may develop into a disease and disseminated hematogenously throughout the body (Matakanye et al., 2019). The active TB can be screened using Interferon Gamma Release Assay (IGRA) or Tuberculin Skin Test (TST). Other common methods of screening include; basic slide microscopy, molecular assay (Xpert MTB/RIF assay) or through conventional culture and Drug Sensitivity Testing. A confirmatory test for pulmonary TB in health facilities is chest radiography(Apriani et al., 2019). TB risk factors though not limited to these include HIV/AIDs, chronic infections such diabetes mellitus, hypertension and cancer, cigarette smoking malnutrition, alcohol consumption and pregnancy (Matakanye et al., 2019).

According to research done, it is evident that most adults have been exposed to TB bacilli but those who develop the disease in lifetime is only 5-10%. The latter however occur mostly within the first and second year of exposure. According to WHO report in 2023 October, the annual infections were reported to be 10.6million with an incidence rate of 133 TB cases per every 100,000person per annum. The increased morbidity and mortality cases were attributed to the emergence of

Multidrug-Resistant TB (MDR-TB) due to poor health support system and non-compliance by the patients among others. The HIV/AIDs has also significantly skyrocketed the mortality cases especially where concomitant exists (World Health Organitation, 2023).

In Kenya despite the clearly outlined TB infection, prevention and controls policy and guidelines by the WHO and International Union of Tuberculosis and Lung Disease (IUTLD) (Agaya *et al*., 2015;Brouwer *et al*., 2015), the occupational related TB is still a major hazard. In Low and Middle- Income Countries, where Kenya falls, implementation especially of the Administrative control measure in the hierarchy has been noted to be poor thus contributing greatly to the disease in spite of being attainable and cost effective at any given hospital (Engelbrecht *et al*., 2016). From the research conducted in Ethiopia and Kenya among others indicated that most facilities were congested with inadequate ventilation inclusive of high-risk areas such as waiting bays, TB wards, medical wards and Laboratory area. Additionally, there were no separate waiting areas for coughing “TB suspects”, no triage carried out as well as provision of tissues or surgical masks to suspects. In a research conducted in Makindu and Kiambu District Hospitals, professional nurses, laboratory staff, nursing and medical students in that order were the regarded as high risk groups among the HCWs (Uden *et al*., 2017 ;Kanyina *et al*., 2017).

The prevalence among HCWs was reported to be higher by three times than the general population (Tudor *et al*., 2016)16 ;Uden *et al*., 2017). This was consistent with a study carried out both in Central and Western region of Kenya. Concomitant with HIV/AIDS, emergence and re-emergence of both multi-drug resistance strains and extremely drug resistant strains (XDR-TB) in Kenya was cited as major

contributors. The HCWs higher risks were attributed to longer duration of exposure to patients on the bedside especially in admission wards where they spend more time attending to them. Moreover, these places are highly concentrated with doses of the bacilli droplet nuclei hence more likely to inhale while working (Brouwer *et al*., 2015 ; Zumla *et a*l., 2013). In a study conducted in KNH on TB regimen outcomes among the HCWs in 2013, the notification rate, that is the number of TB cases brought to National Authorities on New and Relapse cases- stood between 41-901 per 100,000 persons. A situation which was described as inadmissibly and intolerably high compared to the general population (Wahome *et al.*, 2013).

The remedy to occupational TB is a product of complete adherence to TB IPC in any given healthcare set-up in terms of engineering, administrative, environmental and personal respiratory protective measure (PRP). However, the success of the implementation of these guidelines is dependent on support system by the managerial team(Tan et al., 2020). This has reported a reduction in the incidence of TB by 27%-81% based on the country's burden (Kanyina *et al*., 2017).

1.2 Problem Statement

HCWs are greatly affected by Occupational diseases with Tuberculosis being one of the lead diseases in Healthcare settings according to the report released by the World Health Organization (World Health Organization, 2021). Among all the cadres, nurses and the laboratory staff are among the high risk group as far as acquiring both LTBI and active TB is concerned with odds ratio of three (OR-3) in comparison to the rest of the population (Adu et al., 2020) (Uden et al., 2017). This is more prevalent in referral hospitals like KNH and Mbagathi Hospital. These two government hospitals receive massive population in TB diagnosis, treatment and

management both by the population within and without due their accessibility, affordability and quality services. KNH serves as the largest TB diagnostic Center in the country handling most of the multi-drug resistant strains of TB (MDR-TB) with Mbagathi Hospital currently specialized in handling communicable diseases-majorly Tuberculosis Infection with the prevalent of the pandemic rated at 22% according to the retrospective study conducted in 2017 (Prevalence et al., 2017). Moreover, averagely KNH diagnoses 200-300 cases of Tuberculosis cases per month (12% of all diagnosed cases in all the counties) and is referred as the largest referral hospital in both East and Central Africa with approximately 2,000 bed capacity and records at least 80,000 in-patients on annual basis (Makori et al., 2021). Further, the HCWs spend more hours with the in-patient and for longer hours hence a greater magnitude of exposure resulting to high rate of infection and transmission among them (Matakanye et al., 2019).

The study was to establish the socio-demographic risk factors, associated with compliance to TB IPC guidelines among the HCWs in the two referral hospitals. The knowledge level of the HCWs in regard to TB IPC guidelines was assessed as well as their attitude level. The compliance was also established using the WHO tool so as to determine the control measures established in preventing occupational TB. The results would be used in strengthening the knowledge inadequacy noted, provide the base line data for the hospitals which is currently un-available and ensure formulation and implementation of appropriate policies as an administrative control measure, the most effective tool in mitigating for this occupational disease.

1.3 Justification of the Study

Essentially, according Occupational Safety and Health Act (OSHA) 2007, every worker is entitled to safe and healthy environment that has been mitigated for occupational accidents and diseases by the employer. The document emphasis is on factories and other workplaces with an oversight when it comes to medical industry(*LAWS OF KENYA T He O Ccupational S Afety and H Ealth A Ct*, 2010). The study will form a baseline data that shall create awareness on existing morbidity within the community hence lead to prevention and control measure being put in place. According to the study conducted locally and across South Africa, HCWs are three times more likely to contract the disease compared to the general population with nurses and laboratory staff being the highest risk cadres (Adu et al., 2020) ; (Kanyina et al., 2017a). The financial burden as a nation and globally would reduce drastically if the findings are implemented hence improved lifestyle since the huge fund allocated to treat the disease (both by international donors and local government) would be channeled to transforming lives socially and economically e.g. fighting drought and famine among others(Suleiman & Mavisi, 2018); (Chaitkin & Githinji, 2017); .

Moreover, the hospitals will be able to make informed decisions in policy making on how to minimize nosocomial TB among healthcare workers-this would translate to increase in production output with reduced costs that come with absenteeism, compensations, staff turnover, and treatment of the sick staff among others. Also the study is an ongoing intervention globally and at national level thus will ultimately be contributing significantly toward the Sustainable Development Goals (SDGs) indicators of Ending TB by 2050 and eradicating extreme poverty (comes in

managing the pandemic), through the observations that will be made couples with recommendations thereof (World Health Organitation, 2023).

1.4 Research Questions and Hypothesis(es)

1.4.1 Research Questions

1. How does socio-demographic factors inform TB IPC policies among HCWs in Kenyatta National Hospital and Mbagathi County Hospital?
2. What is the level of compliance of TBIPC policies among HCWs in Kenyatta National Hospital and Mbagathi County Hospital?
3. To what extent are HCWs informed on TB IPC policies in Kenyatta National Hospital and Mbagathi County Hospital?
4. How does HCWs attitude affect TB IPC guidelines compliance in Kenyatta National Hospital and Mbagathi County Hospital?

1.4.2 Hypothesis

The research will raise literature knowledge that will help identify the level of compliance to TB IPC guidelines by Health Care Workers. This in return shall inform the hospital management team on the best practices to implement in complying with TB IPCs guidelines especially in the cases of lapses and fatigue. As a ripple effect, HCWs will be compliant and hence lowering disease transmission. Nationally, MOH policy makers can utilize the study in informing increased financial mobilization to the hospitals in study owing to their patient inflow regionally and continentally. The study also contributes to Sustainable Development Goals (SDG) 3vision 2030, the end of the epidemics of AIDS, TB, Malaria among other communicable diseases.

1.5 Objectives

1.5.1 Main Objective

Establish the TB IPC compliance among HCWs in Kenyatta National Hospital and Mbagathi County Hospital?

1.5.2 Specific Objectives

1. To identify demographics informing compliance to TB IPC guidelines among HCWs in Kenyatta National Hospital and Mbagathi County Hospital.
2. To assess the compliance of TB IPC guidelines among HCWs in Kenyatta National Hospital and Mbagathi County Hospital.
3. To assess the knowledge of TB IPC guidelines by HCWs in Kenyatta National Hospital and Mbagathi County Hospital.
4. To assess the attitude of HCWs on TB IPC guidelines in Kenyatta National Hospital and Mbagathi County Hospital.

1.6 Study Limitation

TB is an airborne disease. Every worker in a hospital is at risk even though the research is limited to some few HCWs and yet it is expected to generate data that will be all inclusive. The outcome therefore will be generally limited to the similar set ups of the research. This study could also not widen its scope owing to limitation in funding and constrains of time. While conducting the research, key informants are critical to data generations. However, owing to the schedules of such players the research time is so squeezed to obtain all the data sought.

1.7 Conceptual Framework

The framework of the concept outlines the similarity of the fixed variables to the dependent variable as illustrated below:

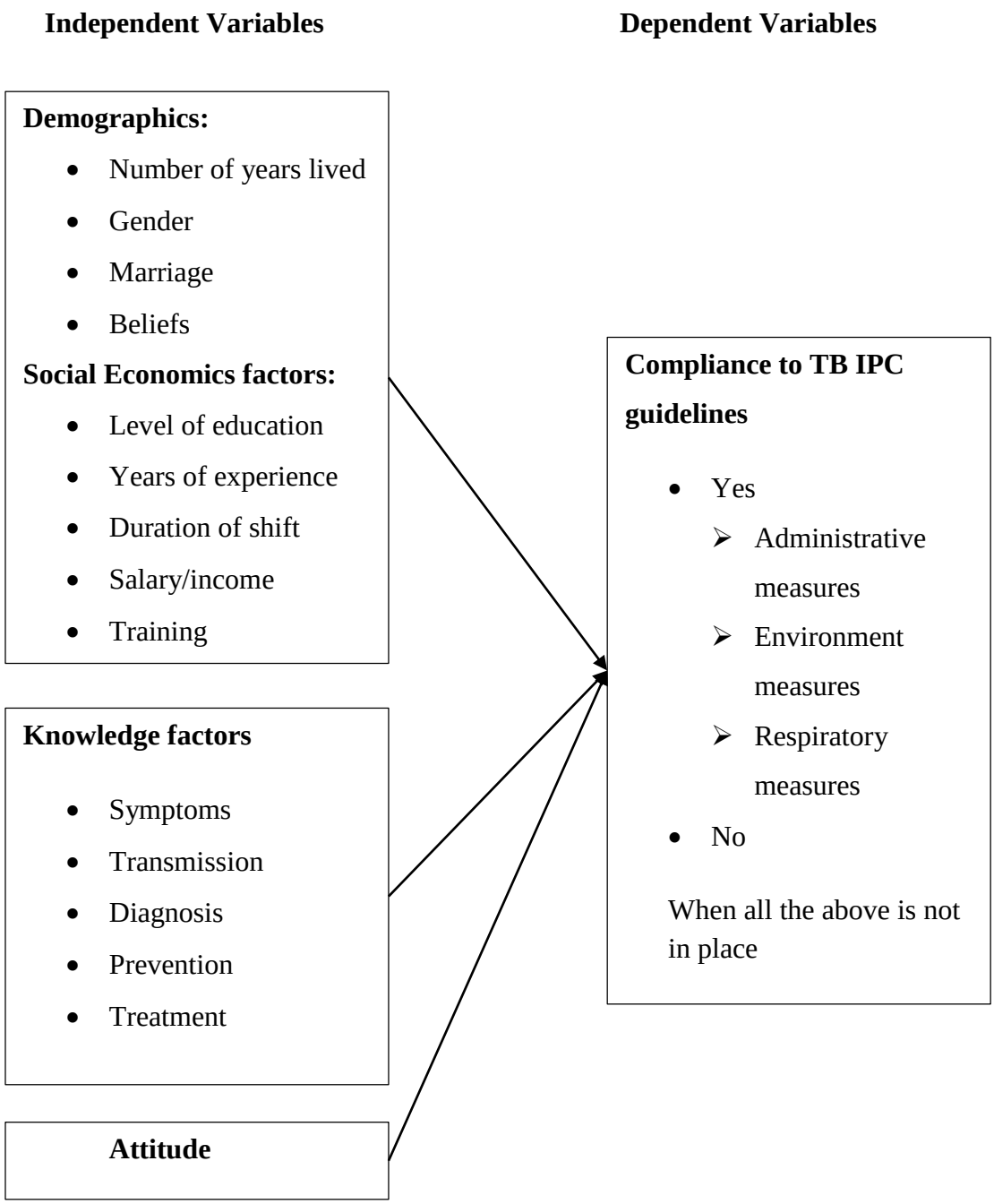


Fig 0.1: The Framework of the concept: Adopted and modified from Hospitals Infection, Control and Prevention Model by B. Gordts (2005).

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Mycobacterium tuberculosis causes tuberculosis disease. It is an obligate pathogenic bacterium in the family of Mycobactericidal. It is non-spore forming, aerobic, non-motile and acid-fast bacillus. It stains purplish-red beads in a chain form when stained with Arly methane dyes e.g. auramine, rhodamine or carbolfuchsin, the latter being the most commonly used. (Saraswati *et al*., 2018). It does not stain using gram stain. The infectious dose for TB is 1-10 microorganisms though there is no "safe" level of exposure since this is independent on one's level immune-competence. Therefore, the HCWs are at a greater risk of contracting the disease during the processing of the "suspected" specimens. *Mycobacterium tuberculosis* infects 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 (Matakanye et al., 2019).

Infection, Prevention and Control (IPC) measures are recommendations by both the WHO and IUTLD in regard to occupational Tuberculosis among the Healthcare workers and the patients in health care facilities. However, adherence to the recommendations in Low Income and Middle Income Countries (LMICs) has been hampered by scarce resources which otherwise have provided hierarchical control measures like engineering controls and PRP (H.-M. van der Westhuizen et al., 2022).

2.2 Tuberculosis among Health Care Workers

This is the main occupational infection among (HCWs). Research indicates that 25-5,361 persons per 100,000 per annum acquire the infection in low-middle income

countries and less than 10 persons in 100,000 per annum in high-income countries. Although 54% of all HCWs have LTBI in the former category, higher numbers have been a concern on those exposed for longer hours in isolation rooms and longer duration of employment (Marais et al., 2019). NLTD report indicated that 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 (National Tuberculosis Leprosy and Lung Disease Unit - Ministry of Health, 2014). Equally, both medical and nursing students showed similar trend. In developed countries occupational cases were significantly low attributed to stringent guidelines to prevent TB but in developing countries, no strategic plans in place owing to limited finances. However, according to the WHO, good work practice and administrative control measures have the greatest impact in prevention of TB transmission in healthcare setting (WHO, 2019).

In the countries with high income, the main strategies utilized in prevention of the disease on HCWs especially, the nursing staff and laboratory personnel include but not limited to the following; firstly, standard diagnostic and prompt treatment plan is used as an administrative control-to patients confirmed with TB and those suspected of it. This is paramount in mitigating for further transmission of the respiratory diseases (Read et al., 2021). Secondly, creation of isolation rooms serves as an environmental control- to minimize droplets concentration in the air and hence reducing the transmission. Thirdly and finally is the use of respiratory protection control as part of the Personal Protective Equipment (PPE) especially where TB is unavoidably high in concentration (Kallon et al., 2021). Not only nationally but also globally, tuberculosis is a big occupational hazard among medics due to consistent

and routinely occupational exposure (Uden *et al*., 2017). The nurses and laboratory workers are among the profession cadre who are considered as high-risk groups for both Latent Tuberculosis Infection (LTBI) as well as active TB while the administrative staff are the lowest risk group. This has been confirmed by the 2010-2013 research conducted in Makindu and Kiambu Kenya. The other cluster of HCWs that seemed to be affected is both medical and nursing students (Kanyina *et al*., 2017) ; (Fadare et al., 2020).

In a research conducted in Kigali Rwanda, TB prevalence in the general population was at 39% while that of HCWs was at 62% (Uden *et al*., 2017). This public health challenge indicates that there is a higher risk of infection among healthcare workers linked to the general population (Brouwer *et al*., 2015). The risk of contracting TB is three times more among the HCWs (Tudor et al., 2016) ; (Uden *et al*., 2017). It was also noted that hospitals with higher admissions of patients with TB, 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 addition, studies done in Russia and South Africa, revealed that TB disease was more prevalent 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 Implementation of full hierarchy of IPCs as outlined by WHO on the other hand has reduced occupational TB cases (Domkam et al., 2018). However, concomitant 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 (Engelbrecht *et al*., 2016) ; (Tudor *et a*l., 2016).

It is common practice for most hospitals to treat both HIV and TB co-currently, but 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. A retrospective study conducted in Western Kenya Kisumu region on TB and Latent TB infection among HCWs in 2013, showed that self-reported history of TB was more prevalent (7.4%) among the HCWs than the general population (3.6%) (Tan et al., 2020).

2.3 TB presentation and prevalence

Since its emergence in 1993, tuberculosis is a global pandemic disease that poses a major public health challenge. The challenge has further been complicated by re-emergence and evolvement of a multi-drug resistant strain (MDR TB). The MDR-TB is usually occasioned by not only non-compliance on patients but also incomplete treatment of anti-TB therapy among the challenged patients such as the immigrants and the homeless (McGowan & Blumberg, 1995). The WHO launched a stop TB strategy in 2006 which was linked to the Millennium Development Goal 6 that ensures that the TB transmission was reversed by 2015. It also published and issued a comprehensive report on October 2023 where 10.6 million people developed tuberculosis by 2022 with 30 high TB burden countries constituting of 80% of the total Positive cases. Kenya has been included as one of the countries recording significant cases of TB including MDR/RR-TB (World Health Organization, 2021).

It was also learned that about 3million people were not in the report issued either because they were either not diagnosed or were actually diagnosed but never reported. Besides, a fifth of MDR cases were detected but not treated posing a greater threat in transmission of MDR TB regionally and globally. This has raised a

dire need for more funding to the tune of USD2 Billion per year to fight the disease. More aid was also committed by The United Kingdom Government's Department for International Development (DFID) to not only £ 1Billion between 2014-2016 but also deliver free treatment to 1 million persons infected with tuberculosis (Zumla *et al*., 2013). A global TB strategy framework was put to place in 2015 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 2030. To realize this target which 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 strategies were put forward. These included; provision of integrated patient-control and prevention; establishment and integration of bold policies and support systems and finally carry out intensified research and innovations (*Tuberculosis*, 2020).

TB is still a major public health problem in sub-Saharan African countries. This is because of scarce resources, occasional insufficient trained personnel and heavy workload among others (Islam et al., 2020). The challenge has been exasperated by the high prevalence and incidences of HIV/AIDS disease with 7-10% of persons with untreated HIV infection developing the TB disease per year (Mosissa *et al*., 2016). TB disease burden in Kenya is collectively 80% of the global burden and hence 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 (Wanyonyi *et al*., 2017). HIV/AIDS prevalence has raised the incidence of TB by 10 since its emergence in

1990s. The PLWHA were the worst hit owing to low socio-economic status that contributed to poor nutrition, peri-slum dwellings and limited/inaccessible health facilities (NIPC, 2016).

In Kenya, in 2017, the national Tuberculosis budget in Kenya was US $62 million with 41% fund to be sourced internationally while 18% more to be domestically collected. Contrary, the other 41% deficit was not financed and thus posing a challenge in fighting the disease. The National Tuberculosis, Leprosy and Lung Disease division (NTLD) report as at 2016 indicated that the household prevalence was 558 cases per 100,000 persons whereas 40% remained undiagnosed hence untreated. This poses a risk of further spread and could result in higher numbers of Multi drug resistance strains among the infected (Chaitkin & Githinji, 2017). It is therefore important to treat both the latent TB as well as the TB disease cases if the 2030 Stop TB target is to be realized (World Health Organitation, 2023).

The front liners of the battle against tuberculosis (TB) are the HCWs. And because TB is airborne, this situation leads to a challenging working atmosphere for healthcare workers, particularly in low- and middle-income countries with a high prevalence of tuberculosis (TB). In these regions, healthcare workers face an elevated risk of infection because they are consistently exposed to a higher number of TB patients for extended durations. The increased risk is exacerbated by inadequately implemented, and occasionally non-existent, infection control measures. Additionally, the prevalence of undiagnosed TB within healthcare facilities adds to the complexity, further heightening the risk of tuberculosis infection among healthcare workers. (Randall et al., 2021). 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 hospitalized for drug-resistant TB (DRTB) than the population they care for (Engelbrecht *et al*., 2019).

2.4 Socio-demographic and risk factors associated with TB

Upon contact with Mycobacterium bacilli into the lungs, the immunocells phagocytize the foreign cells. However, routine exposure to bacilli increases infectious dose especially in HCWs who spent longer duration on TB patients leading to development of the latent tuberculosis infection into active TB. There are two major predisposing factors to occupational TB among HCWs listed as exogenous factors and endogenous factors. Endogenous factors originate from the host and plays a key role in acquiring the disease. Both exogenous factors and endogenous risk factors determine the progression from exposure to the tuberculosis bacilli to the development of active disease. (Isara & Akpodiete, 2015).

Exogenous factors on the other hand, augments the transition from exposure to infection is influenced significantly by factors such as the bacillary load in the sputum and the closeness of an individual to someone with infectious tuberculosis (TB). These elements play a crucial role in determining the likelihood of infection during the progression from exposure to the contraction of TB. Moreover, these key factors are similarly influenced by an intrinsic combination of the infectiousness of the source case with proximity to contact, social and behavioral risk factors because they compromise the cell-mediated immunity (H. M. Van Der Westhuizen et al., 2020). The intrinsic factors are as follows: firstly, chronic diseases and their regimen

such as Diabetes mellitus (DM), chronic renal failure (CRF), and cancer treatment among others. Secondly, surgeries and solid organ transplant (where immune suppression is performed to check incompatibility). Other intrinsic factors include but not limited to malnutrition/underweight cases; old age; intravenous drug use particularly when HIV transmission is a risk factor; unhealthy lifestyle like tobacco smoking and alcohol dependency; pregnancy as well as in TB survivors (Mwenya & Stapley, 2020).

These risk factors produce varied health outcomes/consequences ranging from TB treatment failure to increased TB relapse to even death. In expectant women, it may lead to premature birth and perinatal death; while for people with TB relapse may end up with multidrug-resistant TB and poor treatment outcome. Delayed or failure in early diagnosis and treatment of the persons with TB, enhances the community transmission and the same time the patient risks poor treatment outcome, and also financial constraints as well as health sequelae (Adu et al., 2020).

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 compromises the performance of lungs leaving it highly susceptible to developing TB from a dormant LTBI (Colvin et al., 2021).

2.5 Knowledge on Tuberculosis

The level of knowledge on TB IPC among HCWs is vital tool in ensuring compliance to the guidelines hence reduction to occupational TB. In a research conducted in Free Town Province, South Africa, highly knowledgeable respondents were 4 times more likely to have good practices as contrasted with respondents with lower levels of knowledge (Engelbrecht *et al*., 2016).

2.5.1 Symptoms of Tuberculosis

TB manifests itself with persistent cough for a period of two weeks, fever with night sweat , sudden weight loss, tiredness and fatigue, loss of appetite and swelling around cervical region, Chest pains and shortness of breath (Saraswati *et al*., 2018). Laboratory TB diagnosis include: microscopy, cultures and molecular assay-nuclei acid amplification (NAATs). Other methods of diagnosis are chest X ray imaging which is expected to be widely adopted with increased usage of advanced technological advancements (digital radiology and computer-assisted interpretation) and antigen detection tests which are minimally endorsed by WHO despite their commercial suitability (Pai *et al*, 2016).

2.5.2 Transmission of Tuberculosis

Inhalation of droplets containing the bacilli from an infected person is the main mode of transmission. This occurs majorly via coughing and sneezing without observing the personal hygiene practice of covering one's mouth. Laughing, talking and singing have also been implicated as a mode of transmission (NIPC, 2016) ; (Dinkele et al., 2022). The infected droplets exhaled remain suspended on air and are readily blown away to varied areas. While in the air, evaporation of the secretion takes place and micro-droplet nuclei less than 5μm in diameter is left behind. In case

it is inhaled into the lungs, it reaches the alveoli which is its primary infection site where engulfing and phagocytosis by the macrophages (immune cells) residing in the lungs occurs. (National Tuberculosis Leprosy and Lung Disease Unit - Ministry of Health, 2014). In a duration of 2-8 weeks, the macrophages form a granuloma (barrier wall) to contain the dormant tubercle bacilli from spreading and hence producing Latent Tuberculosis Infection (Read et al., 2021). During this period, the victim will test positive for both serologic Skin Tuberculin Test and Interferon Gamma Release Assay. Should the infection be severe and the immunocells are incapable of neutralizing the bacilli, the bacilli will subvert and replicate in the macrophage resulting in dissemination to the lymph nodes. Eventually, they will be distributed hematogenously throughout the body; triggering cell-mediated immunity to lounge the attack. In spite of these events, the victim remains asymptomatic and even radiological scan shows negative result. However, the tuberculin skin test (mantoux test) and the Interferon gamma Release Assay(IGRAs) test positive (Dunn *et al*., 2016).

2.5.3 Tuberculosis Diagnosis

Tuberculosis is easily diagnosed by means of performing a sputum smear microscopy. In this method, visual evidence of bacilli is key and is thus highly recommended in TB control globally in determining the disease burden epidemiologically. Firstly, the smear microscopy is obtained by digesting and concentrating the sputum (which is received in a tightly capped non- reusable and disposable container) using 1% sodium hypochlorite. This digestion and concentration of the sputum would in turn increase the sensitivity of the ZN stain as well as ensure the safety of handling the specimen by killing the tubercle bacilli.

Smear microscopy diagnostic method is inexpensive, fast (taking few minutes to obtain the result), easy to interpret results, reliable and very accurate in diagnosing tubercle bacilli in the pulmonary region. However, it is limited particularly if the acid fast bacilli are few/low in quantity for example; a specimen for instance in children (Saraswati *et al*., 2018). This creates a high chance of incorrect diagnosis and hence translates to more community transmission of the disease within as well as increasing the morbidity in the patient. Cases like these require culturing of the specimen in order to multiply the bacilli that could be present but could not be detected by smear microscopy. When the smear concentration has less than one-thousand bacilli per one ml of sputum, there is less than ten percent probability of obtaining a positive result. In contrast, any AFB concentration with a range of 5,000-10,000 per ml of sputum, is likely to test positive for tuberculosis (Mosissa *et al*., 2016).

Apart from smear microscopy, there are other TB diagnostic tools used such as; conventional culture and Drug Susceptibility Testing (DST) which involves inoculating the specimen in Lowenstein-Jensen culture media, and then incubating at 37°C for several weeks for growth to be visible. When the pure growth is eventually obtained, smear microscopy is performed together with some chemical reactions to identify the MTB from other mycobacterium complex. Such chemical reactions done include nitrate reductase assay (NRA) and p-nitrobenzoate (PNB) additive (Garcia et al., 2020). WHO recommends early detection and rapid identification of drug resistance strains as the most effective measure that can be taken to eradicate TB transmission in a community. In 2010, the use of molecular diagnostic tool known as Xpert MTB/RIF assay via the GeneXpert platform was

recommend by WHO as the method of choice for case detection of TB. Briefly, Xpert MTB/RIF assay is a real-time Polymerase chain reaction testing (PCR) which amplifies the nucleic acid of the bacteria by giving a color code if present. It also detects resistant mutations to rifampicin in bacterial RNA polymerase gene. The whole process is closed and completely automated thus guaranteeing safety. It is also characterized by accuracy, high sensitivity and specificity without cross-reactivity with non-tuberculous mycobacteria (NTM). Research has revealed that the sensitivity of all the other diagnostic tools is reduced in patients concomitant with HIV but no significant effect with the molecular assay (Ferreira et al., 2017).

Molecular assay is indispensable where the patient is unable to expectorate high quality and sufficient cough, for instance in infants or in persons with multidrug resistant TB (whether relapse, failure or default cases) or those with HIV co-morbidity. People who have been in contact with confirmed TB patient and those suspected to have had exposure for instance HCWs are screened for TB using these tools; especially the Skin Tuberculin Test or Interferon Gamma Release Assay. However, they are known to be not very reliable and tend to give false negative result in sero-positive patients (Apriani et al., 2019).

2.5.4 Tuberculosis Prevention Measures (Hierarchy of Control)

WHO and IUTLD defines the IPCs measures as the set of activities designed to reduce hospital acquired infections such as TB either to patients and/or healthcare workers (WHO, 2019). In order to implement IPC protocols, the health management teams of any healthcare facility must team up with relevant bodies/arms. This will guarantee adherence and operationalization by all the concerned parties which involves ensuring effective and credible administrative controls, engineering

controls, environmental controls and respiratory measures (Tan et al., 2020). The administrative controls ensure that the following are done: firstly, early diagnosis and prompt treatment of every "suspect", secondly, carry out trainings, thirdly, placing information education communication such as "open window", "stop TB epidemic" among others, fourthly, cough etiquette and placing those with active productive cough on front of queues and creating separate receptions for such cases (Widyaningsih et al., 2021).

On the other hand, environmental control ensures minimum concentration of bacilli aerosols in the atmosphere. This is realized through natural ventilation (like opening windows), mechanical fans and creation of negative feedback pressure within the waiting areas (Colvin et al., 2021). Germicidal ultra violet light (GUV) can also be used in cold climate where windows remain closed as an environmental control measure especially in waiting areas, TB wards, medical wards and laboratory area. Lastly, the utilization of personal protective equipment serves as a barrier between the HCW and the inhalation of biological hazard/bacilli. Such PPEs include use of N-95 masks that filter 95% of aerosols/pathogens in the atmosphere and other protective clothing. The masks are successful in preventing the spread of respiratory infections infection including the SARS-Cov-2 as noted in 2020 pandemic (Dinkele et al., 2022).

The administrative control has proven to be the most effective IPC measure in controlling TB transmission among HCWs according to an observational study carried out. Other safety measures include but not limited to engineering control, and PPE especially the N-95 respirator coupled with appropriate managerial support system (WHO, 2019) ; (Brouwer *et al*., 2015). It has been confirmed that

poorly ventilated isolation rooms with positive pressure is the main predisposing factor to hospital acquired TB. Other noted contributing factors were; multiple lapses of engineering, administrative and personal infection control practices. Comparing HIC and LMIC statistics on TB, HIC's efficacy of TB IPC hierarchy of control measures is marked with drastic decrease of hospital acquired TB among HCWs over the years with prevalence less than 10cases per 100,000 persons. On the other hand, LMIC's data shows cases up to 5,361 per 100,000 persons. This is a cause for worry because majority of the IPC policy implementation statistics has been drawn from HICs in which TB burden is comparatively low. While LMICs data showing higher number of cases than HICs, there is limited known information in terms of implementation/compliance in reducing the disease transmission. (Engelbrecht *et al*., 2016).

2.5.5 Tuberculosis Treatment

The HCWs are highly exposed (especially in high TB burden countries e.g. Kenya) to the mycobacterium bacilli hence the need to have necessary knowledge on TB treatment. The sufficient TB treatment ranging from regimen to administration and treatment should be guided by existing treatment recommendations as stipulated by relevant advisory organizations like CDC and the National Tuberculosis Controllers Association (NTCA). The preferred TB treatment is short-course, rifamycin-based, 3 or 4 month latent TB infection treatment regimens for over 6 or 9 months isoniazid monotherapy. However, appropriate TB management regimen is informed by: firstly, DST results of the presumed source case (if known), secondly, coexisting medical conditions and thirdly, potential for drug-drug interactions.(Mok, 2016)

Therefore, lack of knowledge coupled with negative perspective towards multidrug-resistant tuberculosis (MDR-TB) by Health Care Workers (HCWs) and patients are obstacles to tuberculosis control programs. In a research carried out in Nigeria, HCWs of low education status were noted to have poor knowledge on TB treatment (Isara & Akpodiete, 2015).

2.6 Attitude Factors on TB IPC guidelines

The HCWs generally are exposed to both typical TB and drug-resistant strains TB especially those working in TB laboratories, TB wards, medical wards, outpatient department and pediatric ward. A retrospective cohort study conducted in South Africa on TB among HCWs revealed that those who worked or had worked in those areas reported a higher incidence in acquiring TB. Additionally, those who HCWs who were seropositive were twice at risk of contracting TB than the HCWs who were HIV-negative (Tudor *et al*., 2016). This therefore emphasizes the need for periodic screening of TB among HCWs accompanied with confidential care and treatment to reduce stigma among colleagues which has been cited as a big hindrance, to then seeking for help to cure the occupational TB (Wouters *et a*l., 2016); (Garcia et al., 2020).

However, in most hospitals despite the fact that the prevalence of TB acquisition was thrice higher in HCWs as compared to the community, most facilities do not have compensation policy, respiratory protection program and screening policy in place (von Delft *et al*., 2015). As a result, the HCWs are afraid handling patients who have tested positive. The situation is aggregated by inadequate skills on use of respirators supplied and in some cases lack of PPEs due to limited resources. The HCWs also complained of discomfort while using the respirator thus the non-

compliance observed (Hines *et al*., 2019) . This was also noted a research carried out in Nepal which showed that the 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 (Shrestha *et al*., 2017).

In most health facilities, training generally covers the Infection, Prevention and control policies and guidelines that targets handwashing, occupational infections and other programs to ensure compliance to standards set by the institution with no or little emphasis on TB IPC. As a result, the HCWs develop negative attitude towards patients as their welfare are never taken to consideration yet are on front-line to curb the TB menace. This explains the significant association that existed between their attitude and the level of compliance to TB IPC guidelines. The results were in agreement with a study done in India 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 (Khaund et al., 2018).

In conclusion, frontliners in the battle against TB are the HCWs. Since it is an airborne disease, it compromises the safety of their working environment. This is even worse in low- and middle-income countries bearing a higher burden of TB prevalence. HCWs work in a more risky environment because of exposure to many TB patients over lengthy durations, no or weak implementation of IPC measures as well as numerous undiagnosed TB in the healthcare facilities. (Engelbrecht *et a*l., 2019). A robust safety and health system should be developed and implemented to reduce the transmission of the disease (Garcia et al., 2020).

2.7 Progress and problems of TB research

In general, the probability of people living with latent TB infection progressing to active TB is 5-10% in a lifetime but higher in immunocompromised individuals for instance HIV/AIDS (PLWHAs) which is up to 12-20 times greater. The 2015 WHO global report indicated that 11% of TB infections were sero-positives and this translated to one-third of total mortality cases. This shows that concomitant infections raise mortality rates compared to sero-positives without active TB. To add to this, sero-positive individuals are thirty times at risk of TB infection than the sero-negative persons. This therefore is a wakeup call for vigilance in implementing TB IPC in health care facilities (Gjergji *et a*l., 2017). Globally, Kenya was ranked fifteenth out of the twenty-two countries with high TB burden. MOH 2012 report placed Nairobi leading in TB prevalence at 20,102 cases and 6.3% of total deaths countrywide and contributing 4.8% of total Disability Adjusted Life Years (DALYs) (MoH, 2014) and (National Tuberculosis Leprosy and Lung Disease Unit - Ministry of Health, 2014).

Furthermore, a 2008 survey done in Nairobi region concerning TB infection among HCWs revealed that the infectious dose rose up with every hour of exposure and thus maintaining the prevalence rate ranging between 0.6% and 1.1% per annum (Galgalo *et al*., 2008). Poor implementation of safety measures explains the high infection rate and the subsequent emergence and re-emergence of MDR and XDR especially among PLWHAs.

Similar trend has been observed in both Sub- Saharan Countries and Soviet Union Countries (Brouwer et al., 2015) ; (Zumla et al., 2013) . TB is an occupational hazard, was a result of a study conducted in 2011 which also recommended that

should the IPC policies be implemented, TB cases among HCWs would decrease significantly to as low as 49% in countries with low TB burden, 27% in countries with intermediate TB burden and 81% in countries high TB burden. (Baussano *et al*., 2011). According to WHO incidence rates are classified into three main groups named depending on the estimates as follows: low (less than 50 cases per 100,000 population), middle, (50-100 cases per 100,000 population), and high (more than 100 cases per 100,000 population) (World Health Organization, 2009) ; (Baussano et al., 2011). Occupational exposure with prevalence of 63%(with a range of 33-79%) in HCWs is the main predisposing factor to tuberculosis among the LMICs while non-occupational factors with 24% rate(range of 4-46%) is the major contributor to TB in HICs (Menzies *et al*., 2007).

2.8 Summary of Literature Review

Tuberculosis (TB) is a bacterial infection caused by Mycobacterium bacilli. It is spread through inhalation of aerosols released by an infected untreated person via coughing, sneezing, laughing, talking or even singing. These aerosols can be transferred a far off while suspended in the air (Randall et al., 2021). In the lungs, the inhaled mycobacterium bacilli lounge into the alveoli where they are engulfed and degraded by the immune cells. When the bacilli nucleoli lounged is dormant, it forms a granuloma hence latent Tuberculosis infection. Alternatively, this may develop into a disease and disseminated hematogenously through-out the body (National Tuberculosis Leprosy and Lung Disease Unit - Ministry of Health, 2014).

IUTLD and WHO reports indicated vividly that improper implementation of TBIPC protocols is the major contributor of occupational-related TB among HCWs in healthcare set-up in LMICs where the prevalence rate stands at 5,361 per 100,000

persons per annum. In HICs, the TB is non-occupational with occupational cases scoring 10 cases per 100,000 persons per annum (Agaya *et al.*, 2015; (Brouwer et al., 2015) ; (Engelbrecht et al., 2016). From the research conducted in Ethiopia and Kenya among others indicated that most facilities were congested with inadequate ventilation inclusive of high-risk areas such as waiting bays, TB wards, medical wards and Laboratory area. Additionally, there were no separate waiting areas for coughing "TB suspects," no triage carried out as well as provision of tissues or surgical masks to suspects. In a research conducted in Makindu and Kiambu District Hospitals, professional nurses, laboratory staff, nursing and medical students in that order were the regarded as high risk groups among the HCWs (Uden et al., 2017).

The prevalence among HCWs was reported to be three times higher than the general population. The nurses and laboratory workers were among the profession Occupational groups considered at elevated risk for both Latent Tuberculosis Infection (LTBI) and active TB while the administrative staff are the lowest risk group.(Kanyina et al., 2017).

Occupational TB prevention hierarchy prevention tools include credible administrative controls, engineering controls, environmental controls and respiratory measures with administrative control being regarded as the most effective tool (WHO, 2019). The administrative controls ensure that the following are done: firstly, early diagnosis and prompt treatment of every "suspect", secondly, carry out trainings, thirdly, placing information education communication such as "open window", "stop TB epidemic" among others, fourthly, cough etiquette and placing those with active productive cough on front of queues and creating separate receptions for such cases (Brouwer *et al*., 2015).

On the other hand, environmental control ensures minimum concentration of bacilli aerosols in the atmosphere. This is realized through natural ventilation (like opening windows), mechanical fans and creation of negative feedback pressure within the waiting areas. Germicidal ultra violet light (GUV) can also be used in cold climate where windows remain closed as an environmental control measure especially in waiting areas, TB wards, medical wards and laboratory area (Colvin et al., 2021). Lastly, the use of personal protective equipment serves as a barrier between the HCW and the inhalation of biological hazard/bacilli. Such PPEs include use of N-95 masks that filter 95% of aerosols/pathogens in the atmosphere and other protective clothing (Engelbrecht *et al*., 2016). The study is intended to determine the socio-demographic risk factors that could be influencing compliance to TB IPC guidelines, assess the knowledge level of HCWs on Occupational TB and attitude in relation to compliance.

Ultimately, the fight against Occupational TB among HCWs in our referral hospitals can be worn if adherence to TB IPC is operationalized. This would not only contribute to the wellbeing of the staff but can also help realize the WHO SDG 3 END TB 2030 vision (World Health Organization, 2021).

CHAPTER THREE: MATERIALS AND METHODS

3.1 Research Design

The researcher employed a cross-sectional descriptive study design where both quantitative and qualitative data were collected and analyzed. Semi-structured questionnaires, Key Informant Interviews (KII) and observation check list were used.

3.2 Variables

3.2.1 Dependent variable

The dependent variable of the study was compliance to TB IPC guidelines among HCWs. This was measured using both the semi-structured questionnaires and standardized observation check lists which were customized from the WHO Healthcare IPCs guidelines and protocols. Those who performed entirely every aspect of the guidelines were considered to have fully complied with the TB IPC guidelines while those who were not able to perform one or more of those aspects were considered to have not complied at all.

3.2.2 Independent variables

The independent variables were socio-demographic factors, knowledge and attitudes of the HCWs towards the implementation of the IPCs guidelines in eliminating occupational TB.

3.3 Location of the study

The study was conducted in Kenyatta National Hospital (KNH) and Mbagathi County Hospital, the two referral government hospitals in Lang'ata Sub County, Nairobi County. KNH is located 2.7 kilometers from Nairobi central business via

hospital road while Mbagathi County Hospital is 5 kilometers away via Mbagathi road. These were purposely selected due to their accessibility, affordability and quality health care services.

3.4 Study Population & Target population

The target population included all the HCWs in both referral hospitals within the county of Nairobi: Kenyatta National Hospital and Mbagathi County Hospital while the study population comprised of two cadres, the nurses and the laboratory staff-technicians and technologist.

3.4.1 Inclusion Criteria

Those included in the study were health care workers in the two-profession cadre, that is, nurses and laboratory staff who gave their consent in the two referral hospitals.

3.4.2 Exclusion Criteria

Those excluded from the study were any non-medical professionals within and students on attachment/internship.

3.5 Sampling Techniques and Sample size determination

3.5.1 Sampling Techniques

The two government hospitals were purposely selected and since there are several cadres of HCWs in a hospital setting, each cadre was treated as a stratum with the nurses and Laboratory staff selected as the subject participants as the two are the high-risk groups. Proportionate Stratified Sampling was used to determine the sample size needed from each strata (sampling frame). The individuals per stratum in each hospital were randomly selected proportionately to the desired sample size.

3.5.2 Sample Size

Fisher's *et al* formula by Mugenda & Mugenda 2003 sampling method was used to determine the sample size.

$n=z^2\ pq/d^2$ where n is the number of the population

Z is the significant level of confidence at 95%

P is the prevalence proportion of 60% (Agaya *et al*., 2015)

Q is 1-P

D is the margin error; $0.05 = (1.96^2*0.6*0.4)/0.05^2$

=369 persons plus 10% to cover for non-response rate totaling to 406 persons.

Table 0.1: Sample 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**

3.6 Pilot Study/ Pre-testing of study instruments

The questionnaires were pre-tested with 10% HCWs respondents from Spinal Injury Hospital Nairobi before the full-scale study. The outcomes were used in the modification of the tool in order to ensure its reliability and validity. The two are similar in setting- both are referral hospitals and most times the patients with spinal

and orthopedic cases at KNH are referred for specialized treatment at Spinal Injury Hospital Nairobi. Furthermore, bone TB is also common in Developing nations with spine being the most affected site of infection with 50-69% hence similar to Mbagathi Hospital too. Questionnaires were also deployed to assist observe the natural setting of the facility and HCWs.

3.6.1 Validity

To ascertain validity, the researcher ensured well-structured tools, data triangulation through use of observational checklist, KIIs and self-administered semi-structured questionnaires. The study was restricted to Kenyatta National Hospital and Mbagathi County Hospital.

3.6.2 Reliability

First, test-retest reliability was obtained through administering the same research instruments twice over a given period of time to a group of HCWs in Spinal Injury Hospital, Nairobi. The scores obtained first round and the second round were then compared so as to evaluate the consistency of the results over time. The training of research assistances was also done uniformly to ensure consistency in their reporting and in clarifying of any arising issue.

3.7 Data Collection Techniques

A request letter was written to KNH Human Resource Head to provide the total workforce for the two cadres which would assist in calculating sample size of the research. At Mbagathi County Hospital, the workforce data was provided by both the Head of Laboratory and the Chief Nurse. Later after the approval from Kenyatta University ERC and Nacosti, the researcher reported to respective hospitals Ethics Review Committees for clearances. The letters of approval for data collection were

issued upon satisfaction with the work which were 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 trained research assistants and the researcher administered questionnaires to nurses and laboratory staff. The participants were under constant monitoring, guidance, and supervision from the researcher. Collected questionnaires were securely stored in locked cabinets for the entire study duration, and access was restricted solely to the researcher. This stringent measure aimed to maintain confidentiality and prevent any risk of data loss. Observational checklist was also used to determine the practice and behavior of the HCWs in the natural setting. Qualitative data was obtained from the KIIs and the sessions were moderated by the researcher who took notes of the participants' responses.

3.7.1 Research Instruments

Three research tools were used. Namely; pre-tested semi-structured questionnaires with open-ended and close-ended questions and standardized observational checklist for quantitative data and Key Informant Interviews (KIIs) for qualitative data. The observation checklist was adopted from the WHO IPC Assessment Framework (IPCAF) (*Infection prevention and control assessment framework at the facility level Introduction and User Instructions*, 2018) to give a true picture on the ground on the administrative, environmental and personal protective equipment use to ensure minimal occupational exposure. Also, the previous relevant published study formed the part of the guide. The questionnaires were meant to capture the respondents socio-demographic data, compliance to TB IPC guidelines, knowledge on TB and their level of attitude. There were twenty-two questions on true or false response on knowledge, ten questions on attitude with yes or no response and finally a self-

reported twelve questions on yes or no response on TB IPCs on practices. The KIIs were subjected to Departmental heads of TB wards/clinics, wards, outpatient, laboratories and IPC leaders.

3.8 Logistical and Ethical Considerations

To conduct the research, approval from Kenyatta university graduate school was sought. Ethical clearance was obtained from Kenyatta University Ethical Review Committee. Permit from the National Commission for Science, Technology and Innovation (NACOSTI) after which authorization from Ethics Review Committees of the two hospitals was sought. The authorization letters issued were then delivered to the heads of respective departments under study. An informed consent to participate was sought from each respondent and questionnaires administered. The respondents' names were not recorded on the questionnaire thus anonymity was enhanced. Their responses were kept confidential and used for the purpose of this study only. The results shall be published and disseminated for further action by the hospitals' managements as well as kept for future reference.

3.9 Data Analysis and Presentation

The analysis of data utilized SPSS Version 22. Initially, the questionnaires underwent a thorough check, cleaning, and editing process before being inputted into an Excel program. Subsequently, the data was exported to the SPSS software for further analysis. Quantitative outcomes were visually represented through charts, frequency tables, and percentages. Inferential statistics, including chi-square tests to indicate relationships between study variables and Pearson's correlation for assessing the strength of associations, were conducted. The tests were carried out with a 95% confidence interval, and results with p-values below 0.05 were deemed

statistically significant. Qualitative insights obtained from Key Informant Interviews (KIIs) were cross-referenced with quantitative data in the form of direct quotes and narrations for a comprehensive analysis.

CHAPTER FOUR: RESULTS

4.1 Introduction

This research chapter offers an analysis and findings of the study as established in research methodology based on the data collected in relation to the research objectives. The purpose of this study was to establish compliance with tuberculosis infection, prevention and control guidelines among healthcare workers in two hospitals in Nairobi (Kenyatta National Hospital and Mbagathi County Hospital) by use of semi-structured questionnaires, observation checklist and KIIs.

4.2 Respondents response rate

The study targeted 406 respondents and it managed to get 398 responses. This represents 98% response rate. According to Mugenda and Mugenda (2013), a response rate of 50% is adequate for analysis and reporting; a rate of 60% is good and a response rate of 70% and over is excellent. Based on the assertion, the response rate was excellent.

4.3 Reliability and Validity of the Research Instrument

As mentioned in chapter three, the data instruments for conformity by testing a reliability test and validity.

4.3.1 Reliability Analysis

In assessing the internal reliability of the questionnaire used in this study, Cronbach's coefficient alpha was employed. The alpha values, ranging from 0 to 1.0, serve as an indicator of reliability. A value of 1.0 suggests perfect reliability, while a threshold of 0.70 is considered the minimum level of acceptability for internal consistency (Tavakol et al., 2014). The reliability values for each of the variables are

presented in Table 4.1 below, where it is evident that Cronbach's alpha values for each of the variables were well above the lower limit of acceptability of 0.70.

Table 4.1 Reliability

Variable	Cronbach Alpha Value	Status
Tuberculosis Knowledge	0.731	Acceptable
Attitude Of Health Care Workers	0.773	Acceptable
Practices Of Health Care Workers	0.751	Acceptable

4.3.2 Validity

Validity, in the context of this study, refers to the extent to which the employed test measures its intended construct (Drost, 2011). It signifies the degree to which the results derived from data analysis accurately reflect the phenomenon under investigation (Mugenda et al., 2012). Face validity was established through a comprehensive literature review and peer review, incorporating accepted methods and standards employed in analogous studies. To ensure content and construct validity, the initial questionnaire underwent a pre-testing phase involving 10% of the sample respondents. These individuals were selected from relevant staff cadres with a good understanding of the study, contributing to the refinement of the questionnaire, but who would eventually not be part of the sample. A 100% response rate was realized in the pilot data collection and feedback received was incorporated in the final questionnaire hence improving it and was found to be adequate for final data collection.

4.4 Socio-demographic characteristics of the respondents

4.4.1 Distribution of Socio-demographic characteristics of the 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%). 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%) had not held a continuous medical education. Most 157(39.4%) earned Kshs 50,001 to 100,000, followed by 34.2% (n=136) earning Kshs 30,001 to 50,000.

Table 0.2: 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

4.4.2 Association between socio-demographic characteristics and TB-IPC compliance among the study respondents

From the socio-demographic factors analyzed in the study, number of years worked had a statistical significance with compliance to TB IPC guidelines (P value=0.043).

It showed that those who had worked less than two years in the TB risk areas were more likely to comply than their counterparts.

Further, the study findings indicated that was a statistically significant relationship between participants' salary per month and compliance to TB-IPC guidelines (P=0.003). Those who received < Kshs 30,000 per month were more compliant to TB IPC guidelines than the other categories.

Table 0.1: 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	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%		0.896.539, 1.491)

4.3 Compliance to TB-IPC guidelines

4.3.1 Practices of the HCWs

Table 0.2: Practices of the HCWs

Practice	statement	Respondent response (Yes/No)	Frequency (n)	Percent (%)
Administrative measures	Do you ask the patients if they are coughing and how long?	**Yes**	394	99.0
	Do you isolate those who have been coughing?	**Yes**	350	87.9
	Do you put those coughing in front of the queue thus minimizing their waiting time?	**Yes**	356	89.4
	Do you provide tissues or surgical masks to those coughing?	**Yes**	334	83.9
	Do you order sputum test on suspected TB persons?	**Yes**	373	93.7
	Do you educate patients on cough etiquette?	**Yes**	387	97.2
Environmental measures	Do you keep the window open to increase ventilation?	**Yes**	391	98.2
	Do you explain the importance of keeping windows open to the patients?	**Yes**	388	97.5
	Do you ensure negative pressure within the high-risk area?	**Yes**	367	92.2
	Do you turn off fans when very noisy?	**Yes**	357	89.7
Personal Protective Equipment	Do you use N-95 respirator while consulting or interacting with patients?	**Yes**	340	85.4
	Do you use N-95 respirator in sputum handling?	**Yes**	354	88.9

According to the study findings, 394 (99%) of the HCWs reported that they inquired from the patient if the latter were coughing and for how long with 387(97.2%) stating that they educated patients on cough etiquette. Regarding to environmental factors, 391 (98.2%) stated that they kept the windows open to increase ventilation with 388 (97.5%) explaining to patients the importance of keeping the windows open. Additionally, 354 (88.9%) reported having used N-95 mask in sputum handling.

4.3.2 Compliance to TB-IPC guidelines

The semi structured questionnaires had three sections addressing the compliance measure which assessed three hierarchical preventive measures which included the administrative controls, environmental controls (ventilation aspect) and use of respiratory protective equipment (PPE). The observation checklist as derived from WHO IPC framework was also utilized at the time of study to enhance the data collected on the three-prevention measure. It further aimed at analyzing the engineering controls installed within the facilities which included germicidal UV lamps, hood/fume chambers and creation of negative pressure rooms among others. The KIIs were subjected to Departmental heads of TB wards/clinics, wards, laboratories and IPC leaders to assist in analysis mainly the administrative aspect on existence of appropriate policies, institutionalized goals and their implementation for data triangulation. This also included the challenges they face when it comes to managerial support system and resources provisions among others. The outcome for observation checklist and the KII were discussed in Chapter 5.

According to the study, 62.3% (n=248) complied with TB-IPC standards with 37.7% stating otherwise. This clearly shows that the compliance level is slightly less

than two thirds of the respondents. This is inconsistent with a similar study conducted by (Tamir *et al*., 2016) which revealed that among 662 HCWs, only a third had proper overall TBIC practices.

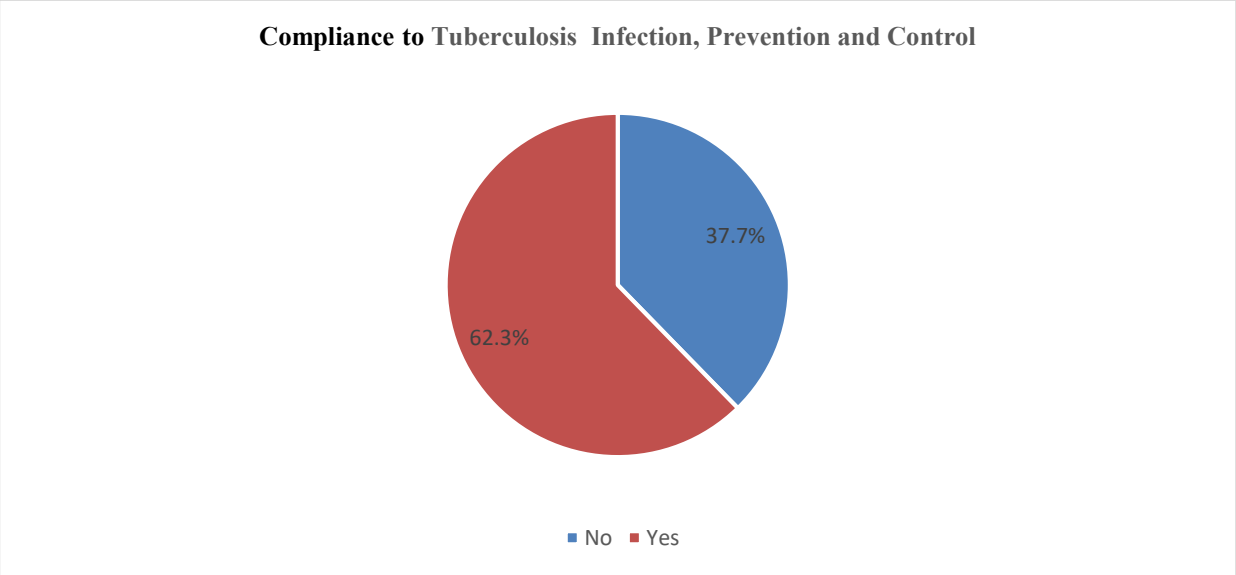


Fig 0.1: Compliance to Tuberculosis Infection, Prevention and Control

4.4 Knowledge factors

4.4.1Tuberculosis knowledge in terms of transmission, diagnosis, prevention and treatment

Knowledge level of individuals was assessed using a number of questions related to TB (refer to the attached appendix). On average, 93.3% of the participants were aware of the symptoms, transmission, diagnosis, prevention and treatment of TB. Furthermore, knowledge gaps were identified in relation to lungs not being the primary target site for TB, smear microscopy results, surgical masks protecting against TB and TB suspects having to queue like any other patient (poor patient separation system).

Table 0.3: Tuberculosis knowledge in terms of transmission, diagnosis, prevention and treatment

Statement	Respondent knowledge response (Correct/Wrong)	Frequency (n)	Percent (%)
Symptoms of TB			
Chronic cough	Correct	377	94.7
Night sweat	Correct	383	96.2
Weight loss	Correct	387	97.2
High fever	Correct	339	85.2
Transmission			
TB is transmitted through Inhalation of the bacilli	Correct	393	98.7
TB is contagious	Correct	393	98.7
Lungs is not the primary target site for TB	Wrong	244	61.3
Diagnosis			
Sputum examination is a major TB diagnostic tool	Correct	392	98.5
Prevention			
BCG vaccination prevents contracting TB	Correct	382	96.0
HIV/AIDS is a pre-disposing factor in contracting TB	Correct	390	98.0
TB persons with negative sputum tests are considered non-infectious	Wrong	205	51.6
N95 masks is not necessary in TB prevention	Wrong	293	73.6
Surgical mask protects against TB	Wrong	166	41.7
Tissues and surgical masks should be given to patients coughing	Correct	348	87.4
Natural ventilation is vital in TB prevention	Correct	382	96.0
TB suspects should be separated from other patients not coughing	Correct	366	92.0
TB suspects should be made to wait on queue like any other patient	Wrong	203	51.0
Coughing patients should be placed in isolated waiting bay	Correct	358	89.9
Prompt diagnosis and treatment is key in eradicating TB	Correct	384	96.5
A HIV positive worker can prevent TB infection through TB IPC strategies	Correct	370	93.0
A HIV positive worker should avoid high-risk areas	Correct	390	98.0
Treatment			
Active TB is curable	Correct	370	93.0
Isoniazid Therapy protects HIV persons from developing TB	Correct	358	89.9
TB treatment takes six months	Correct	373	93.7

4.4.2 TB Knowledge levels

According to the study, 98.5% understood the diagnosis aspect of TB-IPC with 92.2% responding correctly on treatment modalities. On TB transmission, 86.2% responded correctly. Generally, 89.7% on average had a clear understanding of the TB knowledge on transmission, diagnosis, prevention and treatment.

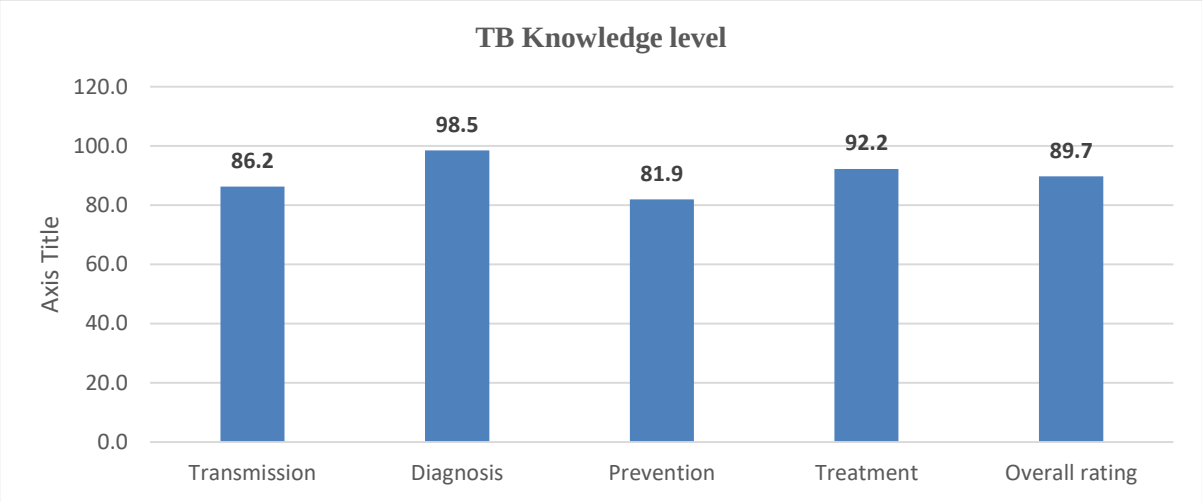


Fig 0.2: TB Knowledge level

Regarding respondents' knowledge on compliance to TB-IPC guidelines, a total of 24 statements were provided to the study participants. The respondents were required to fill in the most appropriate response in form of Correct (True) and Wrong (False). Out of the 24 statements, a score of less than 17 (0-17) statements or below was deemed to be "Low" and Over 17 (18-24) was regarded as "High" knowledge. According to the study findings, 373 (93.7%) had a high knowledge on compliance to TB-IPC guidelines with 25 (6.3%) having "Low" knowledge as shown in the figure 4.3 below.

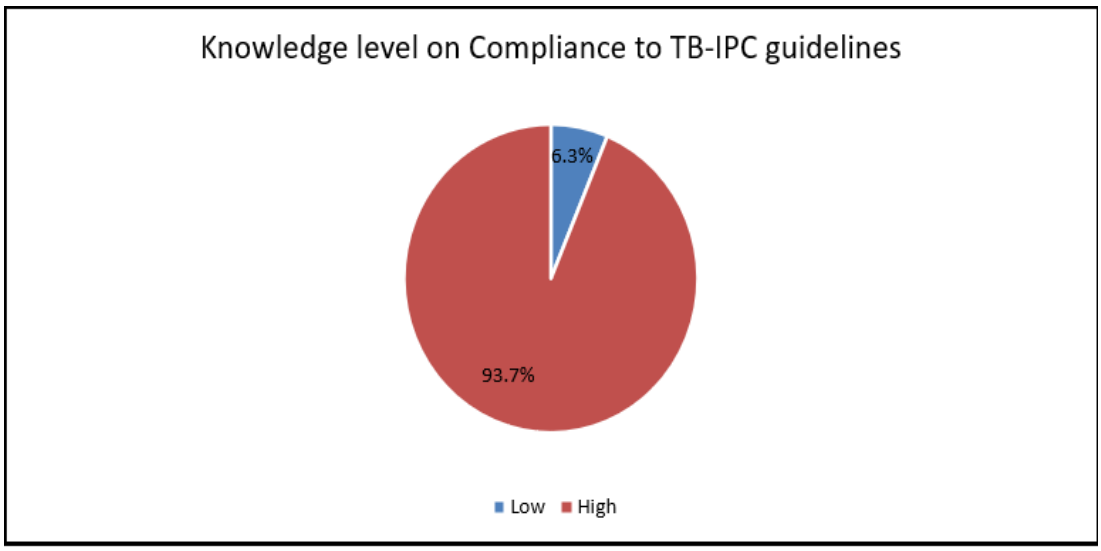


Fig 0.3: Knowledge level on Compliance to Tuberculosis Infection, Prevention and Control guidelines

4.4.3 Association between TB knowledge (Symptoms, Transmission, Diagnosis Treatment and Prevention) and compliance to TB-IPC guidelines

The research sought to determine the influence of knowledge on compliance to TB-IPC guidelines. Table 4.5 below showed the association between TB knowledge (Symptoms, Transmission, Diagnosis Treatment and Prevention) to compliance to TB-IPC guidelines. The results revealed that majority 244 (65.4%) of participants who had high knowledge level on compliance to TB-IPC guidelines had fully complied (OR=1.12 CI: 0.604, 15.613)). A statistical association between TB knowledge (Symptoms, Transmission, Diagnosis Treatment and Prevention) and compliance to TB-IPC guidelines was reported to be statistically significant (P=0.000). Notably, the study findings revealed that respondents who were aware of TB prevention modes are more likely to comply with TB-IPC guidelines (OR=1.528, CI: 1.069,19.852).

Table 0.4: Association between TB knowledge (Symptoms, Transmission, Diagnosis Treatment and Prevention) and compliance to TB-IPC guidelines

Independent Variable	Respondent response	Dependent variable (Compliance to TB-IPC guidelines		Statistical significance	OR (95% C.I)
		Yes	No		
Symptoms	Low	12 (48%)	13 (52%)	X^2=94.715 P-Value=0.000, Df = 1	1
	High	361 (96.8%)	12 (3.2%)		.634 (0.644,5.521)
Transmission	Low	20 (80%)	5 (20%)	X^2=226.129 P-Value=0.000, Df = 1	1
	High	366 (98.1%)	7 (1.9%)		0.051(.237,3.812)
Diagnosis	Low	21 (84%)	4 (16%)	X^2=37.734 P-Value=0.000, Df = 1	1
	High	371 (99.5%)	2 (0.5%)		0.453 (.129, 3.145)
Treatment	Low	19 (76%)	6 (24%)	X^2=36.293 P-Value=0.000, Df = 1	1
	High	366 (98.1%)	7 (1.9%)		.968 (1.636, 4.234)
Prevention	Low	7 (28%)	18 (72%)	X^2=187.246 P-Value=0.000, Df = 1	1
	High	365 (97.9%)	8 (2.1%)		1.528 (1.069, 19.852)
Knowledge Level	Low	4 (16%)	21 (84%)	X^2=24.362 P-Value=0.000, Df = 1	1
	High	244 (65.4%)	129 (34.6%)		1.122 (.604, 15.613)

4.5 Attitude levels

The research sought to determine the attitude levels of the study participants. Regarding respondents' attitude on compliance to 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 form of Yes and No. Out of the 8 statements, a score of 3 or below (0-3) was categorized as "Negative" (Poor), a score of 4 to 6 categorized as "Neutral" (Fair) and Over 6 (7 to 8) was regarded as "Positive" (Good). The cut off points for attitude levels were settled on as illuminated by other alike study such as (Bhebhe et al., 2014a) conducted in Lesotho.

4.5.1 Distribution of attitude levels

The distribution of the attitude levels was as tabulated below;

Table 0.5: 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 of TB IPC that makes you comfortable in 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 believes that you know that may make patients not seek help in hospital or adhere to treatment?	Yes	204	51.3
Respirators are uncomfortable and therefore I prefer not to use in line of duty.	Yes	124	31.2
Is there any need for HCWs exposed to TB patients 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

4.5.2 Attitude levels

According to the study findings, 287 (72.1%) had a neutral attitude level, followed by 85(21.4%) who had positive attitude and 26(6.5%) responding as negative as shown in the figure 4.4 below.

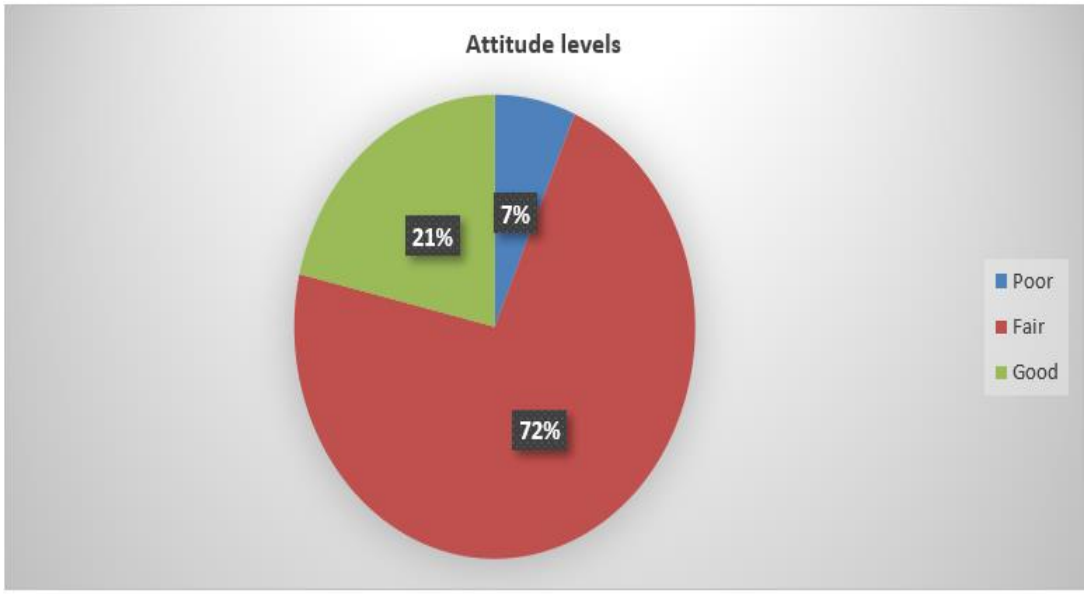


Fig 0.4:Attitude levels of Compliance to Tuberculosis Infection, Prevention and Control

4.5.3 Association between attitude and compliance to TB-IPC guidelines

The research sought to determine the association between attitude and compliance to TB-IPC guidelines. Figure 4.5 below illustrated the association between attitude and compliance to TB-IPC guidelines. The study findings showed that the attitude level had a significant association with compliance to TB-IPC guidelines (P=0.034). Furthermore, participants with positive attitude level were more likely to comply with TB-IPC guidelines (OR=1.688, CI: 1.15, 2.555).

Table 0.6:Association between attitude and compliance to TB-IPC guidelines

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

4.6 Key informant responses.

Key formant interviews were held in at KNH and Mbagathi hospital. The sessions were moderated by the researcher, taking notes of the participants' responses. The responses rate on the KII was at 100%, where 10 participants were interviewed and the responses recorded.

4.6.1 How is the health support within your department/facility in terms of the following aspects?

Respondents were required to give their opinions on health support within your department/facility in terms of the TBCI leadership, resource availability, operational policies and Human capital including collaboration with other relevant stakeholders

4.6.1.1 TBIC leadership

Most of the respondents stated that TBIC leadership was in place in their respective hospitals and areas. Key informant 2,5 and 7 indicated that TBIC committees meet regularly. They added that risk assessments are normally conducted regularly.

According to Key Informant 9

"…The hospital has an IPC department which has representatives drawn from different departments. The IPC is chaired by the Head of IPC department and meet on quarterly basis with impromptu/random assessment conducted in Wards at different times. The data collected advises us on the existing gaps and guides on training to offer during Continuous Medical Education sessions"

Key informant 4 added that

"…The TBIPC is in place and chaired from IPC department. I see them come at random times for spot assessments which is very unfair exercise since it does not represent the true picture of compliance on ground. The meeting is held quarterly during which the assessment report is analysed and recommendations to be implemented issued to the representatives of the department…"

Resource Availability

Different participants had different responses on resource availability.

Key informant 7

"…Yes, the management has shown their commitment by ensuring that processing of sputum is done in hoods and adequately ventilated rooms. Adequate training has een offered to the staff. The PCR technique deployed is highly automated hence significantly reducing the exposure of workers to the bacilli. No suggestions for a better outcome…"

Key informant 10

"...There is need for improvement. Sometimes we do not have adequate basics such as gloves and masks and when you inquire you are told they have been procured and will delivered soon to the department. The Ministry of Health should ensure that the hospitals are adequately funded to mitigate for such crisis..."

Key informant 3 and 4 noted that the management had shown their commitments towards availing commodities and making the space safe and infection free. They further stated that a lot of improvements was required.

4.6.1.2 Operational Policies

The respondents were required to give their views on some of the policies the facility has put in place in regard to TBIC implementation. This entailed regular screening of HCWs of TB, Confidential HIV testing and counselling system for HCWs, Open Window Policy, Maximum natural ventilation policy, Facility TBIC specific policy/SOPs, PPEs issuance policy and In-service and refresher trainings

Key informant 1

"...Yes, we have all the policies in place which have been customized for the institution from the MoH. However, compliance of the same has been noted to be poor. The training is offered and response/behavioral changes of the workers randomly assessed. Regarding HIV/AIDS and TB, workers are expected to conduct the tests voluntarily and adequate support is provided. Never the less no compensation is provided for those who tested positive in line of duty. Maybe we need to consider this as occupational hence compensable..."

Key informant 3,6 and 8 were not aware of the existence of those policies, however they insisted that adherence to open window policy and PPE issuance is followed.

Key informant 10

"...I have not seen any policy, however, if in existence, should be in the custody of the management. None the less we are trained to ensure all windows remain open throughout. During the day, we encourage the patients to spend more time outside basking in the sun to reduce transmission. In most times, we use disposable masks thus no cleaning or maintenance required. We are disappointed that the testing and treatment of HIV/AIDS and TB though voluntary does not offer privacy for the HCWs thus those who test positive and are known are stigmatization among colleagues…"

4.6.1.3 Human capital including collaboration with other relevant stakeholders

Respondents were required to give their opinion on the acceptable threshold of workload; staffing; bed occupancy; and if they had any other relevant stakeholders on board.

Key informant 5,6 and 10 stated that they were understaffed. This increased their workload of having to attend to more patients than required.

Key Informant 2

"...Not very sure however, HCWs have complained of high workload and the staff: patient ratio reported to be greater than the acceptable threshold. I guess the hospital management in collaboration with MoH should de congest the wards by hiring more workers especially nurses in the wards…"

Key informant 7 and 8 respectively

"...We are adequate since most of our diagnostic processes are highly automated. The manual activities were noted to be within the acceptable threshold…"

"…The number is adequate and workload manageable. We however, do not mind an addition few…"

4.6.2 Engineering Measures

Participants were required to give their views on how often machines, apparatus or equipment are disinfected, maintained and/or inspected such as HEPA filters, germicidal UV lights, hood/fume chambers etc.

Key informant 1, 4 and 5 stated that the hospital in-house technicians who regularly inspect, maintain and repair machines.

Key informant 8

"…The germicidal UV lights is regularly checked by the technicians, however we sometimes undergo a major maintenance of the system and this means we relocate the MDR-TB patients to an ordinary room hence increasing the likelihood of the spread of the disease. The Hospital management should consider constructing an alternative isolation room…"

4.6.3 What are the perceptions of HCWs toward the TBIC implementation?

Key informant were supposed to respond to whether there is any non-compliance that had been observed in the past; what could be the reason; what measures had been taken to ensure compliance; what were the main barriers towards the implementation; and what mitigation measures were put in place.

Key informant 2

"…Not major and threatening acts. However, in the wards due to high work load, hand hygiene measure was observed to be poor in our random spot assessments. The nurses- in-charge have been encouraged to enforce the same. However, the

problem can be solved by hiring more nurses on ground. In the meantime, continuous education is continuously being offered among others…"

Key informant 5

"…None that I have observed. All the staff understand the magnitude of the risk at hand therefore compliance is not an option but a necessity for us here…"

Key informant 10

"…The work load is very high and therefore you find some vital measures such as wearing of masks as well as hand washing hygiene neglected. Infact, some prefer wearing more than one pair of gloves to replace hand washing. We have trained and alongside that have issued a duty roaster by the sink where one is expected to tick upon washing their hands. We are at trial stage to see the outcome of this internal measure even as we await the management to add the number of staff in each shift..."

CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Socio-demographic factors

The survey revealed that many of the 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 another survey carried out by (Desta et al., 2018) on knowledge, practices as well as 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 (Mbbs *et al*., 2020) 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 (Habib *et al*., 2020) 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 working at pharmacy, medicine and dentistry while females often worked as nurses and midwives. Furthermore, according to Kenya Nursing Workforce Report (Status, 2012) 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(Status & Professionals, 2015). In fact, men are under-represented in nursing due to nursing perceived of being a profession oriented to females and absence of male hence the need to encourage the men to join the profession (Suleiman & Mavisi, 2018). WHO analysis of 104 states estimated that 70% of the world HCWs were females(Crimi & Carlucci, 2021). 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 determined the participant's number of years worked in a facility. Findings revealed that 61.6% had worked for less than two years, followed by 35.7% indicating three to five years. The short staff retention in the TB high risk was due to the probability of contracting the disease in line of duty which did not have any compensation package or incentives. As a result, the staff kept shifting to other sections or even changing hospitals where a request to rotate them was declined. The study outcome was inconsistent with a survey carried out by (Gichara, 2017)among nurses (n= 379) in Moi and Teaching Referral Hospital, Eldoret which showed that majority of HCWs had worked between 6-10 years. Further, (Wasswa *et a*l., 2015) a research conducted on the adherence of infection controls at Arua district health facilities; 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(Status, 2012), HCWs working in highly specialized areas required extra years to specialize, for example, in critical care, pre-operative, psychiatry and paediatric 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 is required to clear 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 close the gap between international nursing standards and the circumstances daily and that not only did most work long hours without supervision but that the wards were ill-designed (Mcknight *et a*l., 2020). According to a research carried out on Workplace Health and Safety research among the hospital nurses (Mullen, 2015) it was evident that there exists no national standard or shift length for nurses globally and as a result, most end up working up to 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. This was attributed to tight schedules with low staff capacity compared to high turn-up of patients in referral hospitals- seeking general medical services and even specialized treatment which is more likely to be in referral facilities. As a result, majority did not have time to attend the meeting. Interestingly,

those who had not had a CME were 1.68 times more likely to comply with the TB IPC guidelines than their counterpart (CI: 0.8,3.486). 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. Those who had undergone the TB training were more compliant to TB IPC guidelines than their counterpart. However, none had a significant association with compliance to TB IPC guidelines. 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 (Azad *et al*., 2020) highlighted the importance of CMEs among HCWs as this was essential and effective tool to improve knowledge base and thus patient outcomes and quality of care. The study emphasized on training key focus areas such as handwashing, 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 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 licensure required 12-50 hours per year for every HCW. Critical satisfaction factors were identified as follows: adequate training, job security, salary, supervisor support, and manageable workload. This was inconsistent with a research done on HCWs (LMICs) by (Nicol *et al*., 2019)which further revealed that multifaceted training interventions improved 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 in Nigeria (Akwataghibe *et a*l., 2013) which revealed that the estimated monthly salary for healthcare workers in a Hospital setup ranged between USD800 to USD1,000. The researcher in his study 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 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 research done in Jaramogi Oginga Odinga Teaching and Referral Hospital (JOOTRH) (Sewe *et al*., 2020) 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, occupational 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 training has gone down as a result of reduction in number of staff trained per session….*"

5.1.2 Compliance to Tuberculosis Infection, Prevention and Control guidelines

The researcher sought to find out the level of compliance to TB IPC guidelines among the HCWs in KNH and Mbagathi District hospital. The results (62.3%) revealed that majority of the respondents complied with the existing guidelines on TB IPC as stipulated by (World Health Organization, 2021). According to the study, 62.3% (n=248) comply with TB-IPC standards with 37.7% stating otherwise. This clearly shows that the compliance level was less than two thirds of the entire workforce hence the need for continuous training and conscientization. This is inconsistent with a similar study conducted by (Tamir *et al*., 2016) which revealed that among 662 HCWs, only a third had proper overall TBIC practices.

394 (99%) asked patients if they were coughing and for how long. These findings are consistent with a similar research done in Philippines (S. Lee *et al*., 2019)which reported that 89.2% of the patients seeking TB related service always indicated if they were coughing and for how long. Notably, 87.9% of the respondents indicated

that they isolated patients who were coughing and ensure they do not queue thus minimizing waiting time and reducing the risk of spreading any infection. In most cases, isolation rooms have been set aside to act as holding areas for purposes of conclusion of the medical investigation. Most of the respondents 83.9% provided tissues or surgical masks to those coughing. This is dissimilar to an observation that was undertaken during the study period. Through the observation, the patients with coughing symptoms were not isolated, educated on cough etiquette nor were they provided with tissues or surgical masks. Most of the HCWs 93.7% reported that they ordered sputum test on suspected TB persons which is contrary to studies conducted in Maluti Adventist Hospital in Lesotho on 140 HCWs by (Bhebhe et al., 2014b) which indicated that less than a quarter of the suspected TB patients were tested for sputum and provided with surgical masks. This however, is in agreement with the research conducted in South Africa which revealed that good work practices and administrative measured was pointed as a remedy to occupational TB (Mba & Tshitangano, 2014). This was contrary to a research carried out in Nepal where triage was lacking (Weyer *et a*l., 2013) However, there was no isolation bays for TB suspect cases and the waiting bays were observed to be crowded. This was consistent with a research conducted in two district hospitals in Kenya (Kanyina *et al*., 2017).

Respondent 2 indicated that:

> "…. *In the hospital, we have an isolated TB desk to attend to suspected TB patients. However, at the TB clinic there is no waiting bay and all patients wait together in the queue. It takes time to attend to such cases and this leads the likelihood of cross infection. The major challenge we face include lack surgical masks that we can give to the suspected cases. There are no signs of*

how to cough and what procedures need to be followed in case a patient is TB-positive. No IEC materials for staff and patients are provided..."

Concerning environmental measures, 98.2% indicted that they kept the windows open to increase the ventilation and 97.5% explained the importance of keeping the windows open to patients to allow free circulation of air. 92.2% of respondents stated that they ensure negative pressure within the high-risk area with 89.7% reporting having turn off fans when very noisy. The study findings revealed that Kenyatta National Hospital had created negative pressures in the high-risk areas (multi-drug resistant TB ward) yielding a higher dilution of airborne pathogens and consequently reducing the risk of airborne infections. On physical observations, no hospital in the study had installed mechanical fans in the wards to reduce concentration of bacilli. However, natural ventilation, such as open windows, were sufficient to provide adequate ventilation, even if mechanical ventilation was not available according to (J. Y. Lee, 2016) in his research on TBIC in Healthcare facilities with an emphasis on environmental controls and personal protection. Further, he revealed that ventilation alone by nature produced more than 17–40 Air Change per Hour (ACH) than negative-pressure mechanical ventilation which is designed to achieve 6 ACH but recommended at 12 ACH. The latter is expensive to install and maintain and offers limited protection compare to both the natural and mechanical ventilation. On the contrary, a well functional mechanical ventilation in isolation rooms yielded 12 ACH hence natural ventilation provides greater protection for little cost. Further, the research revealed that most staff and patients were encouraged on continuous basis to ensure the windows were always lefts open for free air circulation. However, most of the windows were closed even day time

neither were there “open the window” stickers displayed at strategic points as stipulated in WHO TB IPC guidelines and protocols.

Respondent 3 remarked that:

> *“…In the hospital, we do not have an open window policy to guide us on how we should always ensure adequate ventilation within the facilities. However, we encourage patients and staff to always keep the windows open. Further, we are in the process of acquiring mechanical fans to help in enhancing ventilation ……”*

The poor implementation of administrative measures was regarded as a major contributor of the menace (H.-M. van der Westhuizen et al., 2022). A study conducted in two district hospitals in Kenya (Kanyina *et al*., 2017) revealed that many facilities had an isolation section equipped with germicidal UV lamps and negative pressure. This is contrary to a study carried out where the health facilities had no fans, G UV lights or air filters in use (Flick *et al*., 2017).

Regarding personal protective equipment, 88.9% indicated that they used N-95 respirator in sputum handling with 85.4% stating that they used N-95 when consulting or interacting with patients. These study findings were contrary to observation made by the researcher which showed three-quarter did not use the masks. One of the key informants revealed that there were limited resources thus masks were not always available. This was similar to a study that pointed to lack of adequate disposable respirator as a challenge to HCWs hence increasing the fear of contracting the disease (Engelbrecht *et al*., 2019) The research revealed that respiratory protection program policy did not exist at the time of study which is a significant gap in respiratory protection measure. This disagrees with a research

conducted in Mozambique's where 95% of HCWs used N 95 masks (Brouwer *et al*., 2015) and the policy existed which guided the users on fit-testing, usage, storage and maintenance including the change of respirators filters.

On overall, 62.3%(n=248) of the study participants complied with TB-IPC standards. This clearly shows that the compliance level was less than two thirds of the entire workforce. This is inconsistent with a similar study conducted by (Tamir *et al*., 2016) which revealed that among 662 HCWs, only a third had proper overall TBIC practices.

These findings were in disagreement with a research carried out in Indonesia which showed poor adherence to the guidelines (82.9%) in three Teaching and Referral Hospitals among HCWs despite having good level of knowledge on TB (Gyem *et al*., 2020). A similar research carried out in Kenya showed, compliance to the TB-IPC drastically reduced occupational TB burdens in hospitals by a significant percentage (Kanyina *et al*., 2017 ; (Haeusler et al., 2019).

5.1.3 Knowledge factors

The overall rating of the TB-symptoms based on chronic cough, night sweat, weight loss and high fever was reported as 93.3%. This can be attributed to high likelihood of HCWs able to identify the key symptom as weight loss (97.2%). These study findings are contrary to a study conducted which revealed that HCWs that responded had average knowledge level of identifying TB symptoms at 52% (Alotaibi *et al*., 2019). However, a combination of chronic cough and weight loss are clear indicators of TB. Other studies have shown that a combination of chronic cough, night sweat and weight loss are key attributes associated with TB.

Regarding TB transmission, study results showed that 98.7% TB is contagious and spread through Inhalation of the bacilli. This shows HCWs were well aware of the transmission mode and were prepared well to handle TB related issues. This study findings were consistent with another research done in Brazil (Ferreira *et al*., 2017) which highlighted the key modes of TB transmission as by inhalation. Further, the HCWs information on TB transmission and manifestation was satisfactorily noted (67% and 87% respectively). Notably, 38.7% of the HCWs were not aware that Lungs was the primary target site for TB. This requires rigorous sensitization to prevent transmission.

With regards to the TB diagnosis, study findings revealed that 98.5% acknowledged that microscopy was the main TB diagnostic tool used by HCWs for investigation on TB suspected cases.

Respondent 4 remarked that:

> "…*In the hospital, we majorly focus on sputum examination for testing TB suspected patients. However, in cases where patient results test negative yet clinically all the symptoms are geared towards TB, we conduct Gene-Expert analysis and at times we perform radiological tests that is chest x-ray to ascertain the condition…."*

In responding to prevention mechanisms, HCWs overall performance was 81.9%. The study clearly reiterated that HIV positive workers should avoid high risk areas. This is because the HCWs with HIV are immune-compromised and TB was known to be the major opportunistic infection among seropositive patients. Several studies have been conducted with a recent study on HIV and HCWs indicating that seropositive HCWs should not be deployed in high-risk areas and also should not be

exposed for longer working hours in such high-risk areas. Additionally, 98% revealed that HIV/AIDS was a pre-disposing factor in contracting TB and that BCG vaccination was critical in prevention of TB infection. This was consistent with studies by (Narasimhan *et al*., 2013)that revealed HIV coinfection was the most important and potent risk factor for TB infection and disease. Similar study on the area of TB specialization (J. Y. Lee, 2016) have further and in consistent with this study indicated that natural ventilation was vital in TB prevention with HCWs rating the impact at 96%. In line with WHO guidelines prompt diagnosis and treatment was key in eradicating TB amongst HCWs in the health care setup. However, these study outcome were dissimilar to survey by (Alotaibi *et al*., 2019) that indicated the need to urgently attend to TB suspects without the need to wait in the queues so as to prevent the likelihood of cross-infection. Knowledge gaps were however identified in relation to lungs not being the primary target site for TB, smear microscopy results, surgical masks protecting against TB and TB suspects should be made to wait on queue like any other patient. A similar study carried out on 540 HCWs from 13 hospitals in 13 different countries showed that HCWs had knowledge gap on smear microscopy results, TB screening/diagnosis test, use of surgical masks as the appropriate PPE when dealing with active TB patients and even mode of transmission (Alotaibi *et al*., 2019).This disagreed with a research conducted that revealed that smear-negative patients were expected to have reduced number of bacilli than a smear positive patient. Such however, are still infectious (Narasimhan *et al*., 2013).

Respondent 1 indicated that:

> *"…to effectively curb the spread of TB amongst HCWs and patients seeking treatment in various service points within the hospital, there is*

need to create a separate waiting bay for TB-suspected cases. This will go a long way to ensuring that all the suspects are managed from one point and give proper attention on time…"

As pertains to TB treatment, 93.7% suggested that TB treatment takes six months. This is the estimated number of months it takes for TB patients to respond to anti-TB regimen. However, it only applies to patients that adhere to the treatment with a compliance rate of not less than 95% as reported by KNH HCW in TB section. According to a research conducted by (Ngugi *et al*., 2020) in KNH Comprehensive Care Center (KNHCCC), treatment completion rate was 82% (94/115). Although this was low and fell short of the set global target of 90% and above, it was still acceptable. Notably, 93% of the HCWs agreed that active TB was curable. These outcomes were consistent with MOH (Strategy *et al*., 2015) which has clearly shown treatment success rates among the patients to be above 85%. Further, was observed that among HCWs who developed TB, treatment success rate was lower (75%) than in the general population (>85%), indicating stigma or other constraints to treatment adherence. In the study, the findings indicated that HCWs were well convinced that TB was curable if all measures of treatment were adhered to. 89.9% of the HCWs stated that Isoniazid Therapy protected HIV persons from developing TB due to its ability to reduce the risk of the first TB episode occurring in HCWs exposed to infection or with latent infection and a recurrent episode of TB. This finding was similar to a study carried out in KNH (Ngugi *et al*., 2020) which revealed that Isoniazid preventive therapy (IPT) was an effective intervention in preventing progression of latent TB infection to active TB.

Overall, 373 (93.7%) had a high knowledge level on compliance to TB-IPC guidelines with 25 (6.3%) having "Low" knowledge. This implies that the HCWs

understanding on TB related matters is high. These were similar to studies caried out in Nepal on the knowledge of 190 HCWs to TB IPC (Shrestha *et al*., 2017) which revealed that more than half (54.2%) were knowledgeable with poor score noted among administration and lower level staff. Respondents with high levels of knowledge were 1.1 times more likely to comply with TB IPC guidelines compared to those with low knowledge levels. The findings are consistent too with a study by which revealed that HCWs with high knowledge levels are 4 times more likely to have good practices when compared to respondents with low levels of knowledge.

5.1.4 Attitude levels

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 a risk of developing a multi-drug resistance TB strain. Research conducted in KwaZulu-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 department and paediatric ward (Tudor *et al*., 2016) ; (Engelbrecht *et al*., 2019). 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 (Malotle *et a*l., 2018). 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 is 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. Towards this, 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. The hospital, we have developed a training schedule for all staff working in the 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 on 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 mode of treatment instead of visiting hospitals. Other officers complain of 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 had knowledge on the disease, they expressed a concern of being infected while in line of duty. These findings are similar to a study conducted in Nepal among HCWs which showed that considerable proportion of study respondents (73.2%) had a positive attitude towards compliance to TB IC guidelines despite having poor level of knowledge with a score of 45.8%. This was contributed to the fact that sometimes

the respirators among them were limited (Tartari et al., 2020). Further, the study showed that the more than half of the majority that participated had a concern about being infected with TB due to in adequate knowledge, limited respirators available and lack of triage of TB suspects (Shrestha *et al*., 2017).The results were in agreement with a study done in India 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 (Khaund et al., 2018). The findings agrees with a study carried out on the user acceptance of reusable respirators in health care which showed that the HCWs preferred N95 masks to the reusable ones due to discomfort among others (Hines *et al*., 2019).

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 was also voluntary. This was consistent with a 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 had TB screening in the last one year (Flick *et al*., 2017).

In conclusion, only a few HCWs were willing to be screened and treated due to lack of privacy which resulted to stigma among the colleagues and also the community around (Probandari et al., 2019). A similar study showed that stigma plays a role in delayed diagnosis, poor treatment outcomes and impaired well-being in HCWs who develop TB (Nathavitharana *et al*., 2017).

5.2 Conclusion

1. The results revealed that majority of socio-demographic factors did not significantly influence respondents' compliance to the laid down TB IPC guidelines. The number of years worked significantly affected the compliance to TB IPC among the HCWs.
2. The level of compliance to TBIPC guidelines by the HCWs was noted to be good, slightly lower than two-thirds across the three practices (administrative, environmental and respiratory protection measures. However, in spite the administrative measures being the most effective tool in preventing TB transmission, the observational study carried out showed a poor score, contrary to what the HCWs stated in the semi-structured questionnaires as well as in the Key-informant Interviews.
3. The level of knowledge on TB among HCWs had a statistical significance to compliance to TB IPC with a deficiency of knowledge noted in the prevention aspect of the disease. Those with a high knowledge of TB were more likely to comply with TB IPC than their counterparts.
4. More than two-thirds of the subject participants had a positive attitude rated 1.68 times more likely to comply with TB IPC than their counterparts. Key policies that would assist the HCWs improve on their attitude such as compensation policy, incentive program, TB screening and HIV/AIDS testing and treatment policies were not in place.

5.3 Recommendations

5.3.1 Recommendations from the study

i. The ministry of Health, hospitals' managements and other relevant stake holders should ensure that adequate training on TB IPC is given to all HCWs. These too should sponsor continuous medical education so as to empower the HCWs on compliance to TB IPC guidelines and protocols as stipulated by the WHO.

ii. The Ministry of Health and the hospitals' administration should ensure that the slightly above a-third non-compliance (37.7%) is addressed and necessary management support accorded.

iii. The Ministry of Health and the hospitals' administration should provide adequate supervision among HCWs to ensure that the knowledge acquired is actualized with an emphasize on prevention of TB where deficit was noted.

iv. The management of both hospitals should formulate and implement appropriate policies that are geared towards change of attitude of the HCWs. These include; compensation policy, incentive program, TB screening and HIV/AIDS testing and treatment policies which is user-friendly and confidential to HCWs and respiratory protection program to ensure procurement of appropriate respirators, training on fit-testing, installation of signage in high-risk areas mandatory for respiratory use, supervision and disposal

5.4 Further Research

In order to gain a deeper understanding of the study among HCWs, the researcher recommends the following:

a) A critical review and in-depth analysis of censor data from the two facilities using a larger population done over a long period of time.

b) Carry out a separate research per objective to gain insights on underlying factors.

REFERENCES

Adu, P. A., Yassi, A., Ehrlich, R., & Spiegel, J. M. (2020). Perceived health system barriers to tuberculosis control among health workers in South Africa. *Annals of Global Health*, *86*(1), 1–10. https://doi.org/10.5334/aogh.2692

Agaya, J., Nnadi, C. D., Odhiambo, J., Obonyo, C., Obiero, V., Lipke, V., Okeyo, E., Cain, K., & Oeltmann, J. E. (2015). Tuberculosis and latent tuberculosis infection among healthcare workers in Kisumu, Kenya. *Tropical Medicine and International Health*, *20*(12), 1797–1804. https://doi.org/10.1111/tmi.12601

Akwataghibe, N., Samaranayake, D., Lemiere, C., & Dieleman, M. (2013). *Assessing health workers ' revenues and coping strategies in Nigeria — a mixed-methods study*.

Alotaibi, B., Yassin, Y., Mushi, A., Maashi, F., Thomas, A., Mohamed, G., Hassan, A., & Yezli, S. (2019). Tuberculosis knowledge, attitude and practice among healthcare workers during the 2016 Hajj. *PLoS ONE*, *14*(1), 1–15. https://doi.org/10.1371/journal.pone.0210913

Apriani, L., McAllister, S., Sharples, K., Alisjahbana, B., Ruslami, R., Hill, P. C., & Menzies, D. (2019). Latent tuberculosis infection in healthcare workers in low-And middle-income countries: An updated systematic review. *European Respiratory Journal*, *53*(4). https://doi.org/10.1183/13993003.01789-2018

Azad, A., Min, G., Syed, S., & Anderson, S. (2020). *Continued nursing education in low- - income and middle- - income countries : a narrative synthesis*. 1–8. https://doi.org/10.1136/bmjgh-2019-001981

Baussano, I., Nunn, P., Williams, B., Pivetta, E., Bugiani, M., & Scano, F. (2011). Tuberculosis among health care workers. *Emerging Infectious Diseases*, *17*(3), 488–494. https://doi.org/10.3201/eid1703.100947

Bhebhe, L. T., Van Rooyen, C., & Steinberg, W. J. (2014a). Attitudes, knowledge and practices of healthcare workers regarding occupational exposure of pulmonary tuberculosis. *African Journal of Primary Health Care and Family Medicine*, *6*(1), 1–6. https://doi.org/10.4102/phcfm.v6i1.597

Bhebhe, L. T., Van Rooyen, C., & Steinberg, W. J. (2014b). Attitudes, knowledge and practices of healthcare workers regarding occupational exposure of pulmonary tuberculosis. *African Journal of Primary Health Care and Family Medicine*, *6*(1), 1–6. https://doi.org/10.4102/phcfm.v6i1.597

Boniol, M., Kunjumen, T., Nair, T. S., Siyam, A., Campbell, J., & Diallo, K. (2022). The global health workforce stock and distribution in 2020 and 2030: A threat to equity and â € universal' health coverage? *BMJ Global Health*, *7*(6), 1–8. https://doi.org/10.1136/bmjgh-2022-009316

Brouwer, M., Coelho, E., Mosse, C. D., & Leth, F. Van. (2015). *tb ipc Mozambique . 19*(August 2014), 44–49.

Chaitkin, M., & Githinji, J. (2017). *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.

Colvin, C. J., Kallon, I. I., Swartz, A., MacGregor, H., Kielmann, K., & Grant, A. D. (2021). 'It has become everybody's business and nobody's business': Policy actor perspectives on the implementation of TB infection prevention and control (IPC) policies in South African public sector primary care health facilities. *Global Public Health*, *16*(10), 1631–1644. https://doi.org/10.1080/17441692.2020.1839932

Crimi, C., & Carlucci, A. (2021). *Challenges for the female health-care workers during the COVID-19 pandemic : the need for protection beyond the mask*. *27*(1), 9–11.

Desta, M., Ayenew, T., Sitotaw, N., Tegegne, N., Dires, M., & Getie, M. (2018). *Knowledge , practice and associated factors of infection prevention among healthcare workers in Debre Markos referral hospital , Northwest Ethiopia*. 1–10.

Dinkele, R., Gessner, S., McKerry, A., Leonard, B., Leukes, J., Seldon, R., Warner, D. F., & Wood, R. (2022). Aerosolization of Mycobacterium tuberculosis by Tidal Breathing. *American Journal of Respiratory and Critical Care Medicine*, *206*(2), 206–216. https://doi.org/10.1164/RCCM.202110-2378OC/SUPPL_FILE/DISCLOSURES.PDF

Domkam, I. K., Sonela, N., Kamgaing, N., Takam, P. S., Gwom, L. C., Betilene, T. M. A., Fokam, J., Billong, S. C., Moukam, L. V., Etounou, T. M., Minka, C. S. M., & Ndjolo, A. (2018). Prevalence and risk factors to HIV-infection amongst health care workers within public and private health facilities in Cameroon. *Pan African Medical Journal*, *29*, 1–7. https://doi.org/10.11604/pamj.2018.29.158.14073

Dunn, J. J., Starke, J. R., & Revell, P. A. (2016). Laboratory diagnosis of mycobacterium tuberculosis infection and disease in children. *Journal of Clinical Microbiology*, *54*(6), 1434–1441. https://doi.org/10.1128/JCM.03043-15

Engelbrecht, M., Janse van Rensburg, A., Kigozi, G., & van Rensburg, H. C. J. D. (2016). Factors associated with good TB infection control practices among primary healthcare workers in the Free State Province, South Africa. *BMC Infectious Diseases*, *16*(1). https://doi.org/10.1186/s12879-016-1984-2

Engelbrecht, M., Rau, A., Kigozi, G., Janse Van Rensburg, A., Wouters, E., Sommerland, N., Masquillier, C., & Uebel, K. (2019). Waiting to inhale: Factors associated with healthcare workers' fears of occupationally-acquired tuberculosis (TB). *BMC Infectious Diseases*, *19*(1), 1–7. https://doi.org/10.1186/s12879-019-4115-z

Fadare, R. I., Akpor, O. A., Ifechukwude, I. G., Richard D, A., & Bello, C. B. (2020). Nurses' Safety in Caring for Tuberculosis Patients at a Teaching Hospital in South West Nigeria. *Journal of Environmental and Public Health*, *2020*. https://doi.org/10.1155/2020/3402527

Ferreira, D., Belo, M. T., Salame, F. M., Cordeiro-santos, M., Ximenes, R. A., De, M., Hill, P. C., Menzies, D., & Trajman, A. (2017). *Knowledge about tuberculosis transmission and prevention and perceptions of health service utilization among index cases and contacts in Brazil : Understanding losses in the latent tuberculosis cascade of care*. 1–16.

Flick, R. J., Munthali, A., Simon, K., Hosseinipour, M., Kim, M. H., Mlauzi, L., Kazembe, P. N., & Ahmed, S. (2017). Assessing infection control practices to protect health care workers and patients in Malawi from nosocomial transmission of Mycobacterium tuberculosis. *PLoS ONE*, *12*(12), 1–13. https://doi.org/10.1371/journal.pone.0189140

Galgalo, T., Dalal, S., Cain, K. P., Oeltmann, J., Tetteh, C., Kamau, J. G., Njenga, M. K., Breiman, R. F., Chakaya, J. M., Irimu, H. M., Miller, B., De Cock, K. M., Bock, N. N., & Ijaz, K. (2008). Tuberculosis risk among staff of a large public hospital in Kenya. *International Journal of Tuberculosis and Lung Disease*, *12*(8), 949–954.

Garcia, R., Spiegel, J. M., Yassi, A., Ehrlich, R., Romão, P., Nunes, E. A., Zungu, M., & Mabhele, S. (2020). Preventing occupational tuberculosis in health workers: An analysis of state responsibilities and worker rights in mozambique. *International Journal of Environmental Research and Public Health*, *17*(20), 1–17. https://doi.org/10.3390/ijerph17207546

Gichara, R. W. (2017). *Burnout in Nurses at a Referral Hospital in Western*. *7*(11), 704–715. https://doi.org/10.6007/IJARBSS/v7-i11/3508

Gjergji, M., Bushati, J., Harxhi, A., & Hafizi, H. (2017). *iMedPub Journals Tuberculosis in HIV / AIDS Patients Abstract Abbreviations : Introduction*. 1–7.

Gyem, K., Ahmad, R. A., & Mahendradhata, Y. (2020). *Implementation fidelity of tuberculosis infection prevention and control practices in three hospitals with the highest notified tuberculosis cases in Bhutan : a mixed method study*. https://doi.org/10.29392/001c.14140

Habib, R. R., Halwani, D. A., Mikati, D., & Hneiny, L. (2020). *Sex and Gender in Research on Healthcare Workers in Conflict Settings : A Scoping Review*.

Haeusler, I. L., Knights, F., George, V., & Parrish, A. (2019). Improving TB infection control in a regional hospital in the Eastern Cape, South Africa. *BMJ Open Quality*, *8*(1), 347. https://doi.org/10.1136/bmjoq-2018-000347

Hines, S. E., Brown, C., Oliver, M., Gucer, P., Frisch, M., Hogan, R., Roth, T., Chang, J., & McDiarmid, M. (2019). User acceptance of reusable respirators in health care. *American Journal of Infection Control*, *47*(6), 648–655. https://doi.org/10.1016/j.ajic.2018.11.021

INFECTION PREVENTION AND CONTROL ASSESSMENT FRAMEWORK AT THE FACILITY LEVEL Introduction and user instructions. (2018). http://www.who.int/infection-prevention/publications/core-com-

Isara, A. R., & Akpodiete, A. (2015). Concerns about the knowledge and attitude of multidrug-resistant tuberculosis among health care workers and patients in Delta State, Nigeria. *Nigerian Journal of Clinical Practice*, *18*(5), 664–669. https://doi.org/10.4103/1119-3077.154212

Islam, M. S., Chughtai, A. A., & Seale, H. (2020). 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. In *Journal of Infection and Public Health*. Elsevier Ltd. https://doi.org/10.1016/j.jiph.2020.02.039

Kallon, I. I., Swartz, A., Colvin, C. J., Macgregor, H., Zwama, G., Voce, A. S., Grant, A. D., & Kielmann, K. (2021). Organisational culture and mask-wearing practices for tuberculosis infection prevention and control among health care workers in primary care facilities in the western cape, south africa: A qualitative study. *International Journal of Environmental Research and Public Health*, *18*(22). https://doi.org/10.3390/ijerph182212133

Kanyina, E. W., Boru, W. G., Mucheru, G. M., Amwayi, S. A., & Galgalo, T. (2017a). Tuberculosis infection among health care workers: a case series in two district hospitals, Kenya, August 2013. *The Pan African Medical Journal*, *28*(August 2013), 4. https://doi.org/10.11604/pamj.supp.2017.28.1.8222

Kanyina, E. W., Boru, W. G., Mucheru, G. M., Amwayi, S. A., & Galgalo, T. (2017b). Tuberculosis infection among health care workers: a case series in two district hospitals, Kenya, August 2013. *The Pan African Medical Journal*, *28*(August 2013), 4. https://doi.org/10.11604/pamj.supp.2017.28.1.8222

Khaund, K., Sudhakar, C., & Vaz, C. J. (2018). Infection control prevention practices on pulmonary tb transmission among health care personnel of selected hospital in India. *Journal of Clinical and Diagnostic Research*, *12*(11), 10–15. https://doi.org/10.7860/JCDR/2018/36029.12235

LAWS OF KENYA T he O ccupational S afety and H ealth A ct. (2010). *2010*(2007).

Lee, J. Y. (2016). *Tuberculosis Infection Control in Health- Care Facilities : Environmental Control and Personal Protection*. *3536*, 234–240.

Lee, S., Lau, L., Lim, K., Ferma, J., Dodd, W., & Cole, D. (2019). *The Presence of Cough and Tuberculosis : Active Case Finding Outcomes in the Philippines*. *2019*. https://doi.org/10.1155/2019/4578329

Makori, L., Gichana, H., Oyugi, E., Nyale, G., & Ransom, J. (2021). Tuberculosis in an urban hospital setting: Descriptive epidemiology among patients at Kenyatta National Hospital TB clinic, Nairobi, Kenya. *International Journal of Africa Nursing Sciences*, *15*(December 2020), 100308. https://doi.org/10.1016/j.ijans.2021.100308

Malotle, M. M., Spiegel, J. M., Yassi, A., Ngubeni, D., O'Hara, L. M., Adu, P. A., Bryce, E. A., Mlangeni, N., Gemell, G. S. M., & Zungu, M. (2018). Occupational tuberculosis in South Africa: are health care workers adequately protected? *Public Health Action*, *7*(4), 258–267.

https://doi.org/10.5588/pha.17.0070

Marais, F., Kallon, I. I., & Dudley, L. D. (2019). Continuity of care for TB patients at a South African hospital: A qualitative participatory study of the experiences of hospital staff. *PLoS ONE*, *14*(9), 1–22. https://doi.org/10.1371/journal.pone.0222421

Matakanye, H., Ramathuba, D. U., & Tugli, A. K. (2019). Caring for tuberculosis patients: Understanding the plight of nurses at a regional hospital in Limpopo Province, South Africa. *International Journal of Environmental Research and Public Health*, *16*(24). https://doi.org/10.3390/ijerph16244977

Mba, T. G. T., & Tshitangano, T. G. (2014). Measures practised by healthcare workers to prevent tuberculosis transmission at rural hospitals in Vhembe District. *Southern African Journal of Epidemiology and Infection*, *29*(2), 65–69. https://doi.org/10.1080/23120053.2014.11441572

Mbbs, B. Y. Q. T., Kanneganti, A., Lim, L. J. H., Tan, M., Xian, Y., Mph, C., Tan, L., Hui, C., Mrcp, S., Denning, M., Bch, B. M., Teng, E., Mbbs, G., Purkayastha, S., Kinross, J., Sim, K., Psych, M., Huak, Y., A, S. B. S. O. F., & Maastricht, M. (2020). Burnout and Associated Factors Among Health Care Workers in Singapore During the COVID-19 Pandemic. *Journal of the American Medical Directors Association*, *21*(12), 1751-1758.e5. https://doi.org/10.1016/j.jamda.2020.09.035

McGowan, J. E., & Blumberg, H. M. (1995). Inner-city tuberculosis in the USA. *Journal of Hospital Infection*, *30*, 282–295. https://doi.org/10.1016/0195-6701(95)90031-4

Mcknight, J., Nzinga, J., Jepkosgei, J., & English, M. (2020). Social Science & Medicine Collective strategies to cope with work related stress among nurses in resource constrained settings : An ethnography of neonatal nursing in Kenya. *Social Science & Medicine*, *245*(November 2019), 112698. https://doi.org/10.1016/j.socscimed.2019.112698

Menzies, D., Joshi, R., & Pai, M. (2007). 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. *The International Journal of …*, *11*(6), 593–605. https://doi.org/http://dx.doi.org/10.1016/B978-1-84334-723-1.50012-7

MoH. (2014). Human Resources Strategy. *Health Sector Human Resources Strategy 2014-2018*, 1–22. https://doi.org/10.1111/b.9780631218616.2006.00024.x

Mok, J. H. (2016). Diagnosis and treatment of latent Tuberculosis infection in healthcare workers. In *Tuberculosis and Respiratory Diseases*. https://doi.org/10.4046/trd.2016.79.3.127

Mosissa, L., Kebede, A., Mindaye, T., Getahun, M., Tulu, S., & Desta, K. (2016). External quality assessment of AFB smear microscopy performances and its associated factors in selected private health facilities in Addis Ababa, Ethiopia. *Pan African Medical Journal*, *24*.

https://doi.org/10.11604/pamj.2016.24.125.7459

Mullen, K. (2015). Barriers to work-life balance for hospital nurses. *Workplace Health and Safety*, *63*(3), 96–99. https://doi.org/10.1177/2165079914565355

Mwenya, S., & Stapley, S. (2020). An exploration of health workers risks of contracting tuberculosis in the workplace: a qualitative study. *BMC Health Services Research*, *20*(1), 1–10. https://doi.org/10.1186/s12913-020-05877-0

Narasimhan, P., Wood, J., Macintyre, C. R., & Mathai, D. (2013). Risk factors for tuberculosis. *Pulmonary Medicine*, *2013*. https://doi.org/10.1155/2013/828939

Nathavitharana, R. R., Bond, P., Dramowski, A., Kotze, K., Lederer, P., Oxley, I., Peters, J. A., Rossouw, C., van der Westhuizen, H. M., Willems, B., Ting, T. X., von Delft, A., von Delft, D., Duarte, R., Nardell, E., & Zumla, A. (2017). Agents of change: The role of healthcare workers in the prevention of nosocomial and occupational tuberculosis. In *Presse Medicale* (Vol. 46, Issue 2, pp. e53–e62). Elsevier Masson SAS. https://doi.org/10.1016/j.lpm.2017.01.014

National Tuberculosis Leprosy and Lung Disease Unit - Ministry of Health. (2014). *Guidelines for TB infection Prevention and Control for Health Care workers in Kenya*. *July*, 1–71. https://doi.org/10.1017/CBO9781107415324.004

Ngugi, S. K., Muiruri, P., Odero, T., & Gachuno, O. (2020). *Factors affecting uptake and completion of isoniazid preventive therapy among HIV- infected children at a national referral hospital , Kenya : a mixed quantitative and qualitative study*. 1–11.

Nicol, E., Turawa, E., & Bonsu, G. (2019). *Pre- and in-service training of health care workers on immunization data management in LMICs : a scoping review*. 1–14.

NIPC. (2016). NATIONAL INFECTION CONTROL GUIDELINES 2016 Draft for Consultation. *National Infection Control*.

Prevalence, T., Mbagathi, I. N., Hospital, D., Mwabu, A. K., Kaari, P., Bii, C., & Makobe, C. (2017). *September 2017*. *94*(9), 749–760.

Probandari, A., Sanjoto, H., Mahanani, M. R., Azizatunnisa, L., & Widayati, S. (2019). Being safe, feeling safe, and stigmatizing attitude among primary health care staff in providing multidrug-resistant tuberculosis care in Bantul District, Yogyakarta Province, Indonesia. *Human Resources for Health*, *17*(1), 1–10. https://doi.org/10.1186/s12960-019-0354-8

Randall, K., Ewing, E. T., Marr, L. C., Jimenez, J. L., & Bourouiba, L. (2021). *How did we get here: what are droplets and aerosols and how far do they go? A historical perspective on the transmission of respiratory infectious diseases*. https://doi.org/10.1098/rsfs.2021.0049

Read, J. M., Green, C. A., Harrison, E. M., Docherty, A. B., Funk, S., Harrison, J., Girvan, M., Hardwick, H. E., Turtle, L., Dunning, J., Nguyen-Van-Tam, J. S.,

Openshaw, P. J., Baillie, J. K., & Semple, M. G. (2021). Hospital-acquired SARS-CoV-2 infection in the UK's first COVID-19 pandemic wave. *The Lancet*, *398*(10305), 1037–1038. https://doi.org/10.1016/S0140-6736(21)01786-4

Saraswati, L. D., Ginandjar, P., Widjanarko, B., & Puspitasari, R. A. (2018). Epidemiology of Child Tuberculosis (A Cross-Sectional Study at Pulmonary Health Center Semarang City, Indonesia). *IOP Conference Series: Earth and Environmental Science*, *116*(1). https://doi.org/10.1088/1755-1315/116/1/012081

Sewe, S. O., Bula, H. O., & Oringo, J. O. (2020). *Compensation Management Practices and Quality of Health Care at Jaramogi Compensation Management Practices and Quality of Health Care at Jaramogi Oginga Odinga Teaching and Referral Hospital*. *4*(10), 72–82.

Shrestha, A., Bhattarai, D., Thapa, B., Basel, P., & Wagle, R. R. (2017). Health care workers' knowledge, attitudes and practices on tuberculosis infection control, Nepal. *BMC Infectious Diseases*, *17*(1), 1–7. https://doi.org/10.1186/s12879-017-2828-4

Status, T. (2012). *Kenya Nursing Workforce Report*.

Status, T., & Professionals, H. (2015). *Kenya Health Workforce Report :*

Strategy, T. H. E. G., For, T., & Prevention, T. (2015). *Global strategy and targets for tuberculosis prevention , care and control after 2015*. 2015–2016.

Suleiman, K., & Mavisi, V. (2018). Tuberculosis : A Gender Assessment in Kenya. *KELIN and Stop TB Partnership*. https://stoptb.org/assets/documents/communities/CRG/TB Gender Assessment Kenya.pdf

Tamir, K., Wasie, B., & Azage, M. (2016). 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 Services Research*, 1–11. https://doi.org/10.1186/s12913-016-1608-y

Tan, C., Kallon, I. I., Colvin, C. J., & Grant, A. D. (2020). Barriers and facilitators of tuberculosis infection prevention and control in low- And middle-income countries from the perspective of healthcare workers: A systematic review. In *PLoS ONE* (Vol. 15, Issue 10 October). https://doi.org/10.1371/journal.pone.0241039

Tartari, E., Hopman, J., Allegranzi, B., Gao, B., Widmer, A., Cheng, V. C. C., Wong, S. C., Marimuthu, K., Ogunsola, F., & Voss, A. (2020). Perceived challenges of COVID-19 infection prevention and control preparedness: A multinational survey. *Journal of Global Antimicrobial Resistance*, *22*, 779–781. https://doi.org/10.1016/j.jgar.2020.07.002

Tuberculosis. (2020). https://doi.org/10.1787/f494a701-en

Tudor, C., Van Der Walt, M. L., Margot, B., Dorman, S. E., Pan, W. K., Yenokyan, G., & Farley, J. E. (2016). Occupational Risk Factors for Tuberculosis among Healthcare Workers in KwaZulu-Natal, South Africa. *Clinical Infectious Diseases*, *62*(Suppl 3), S255–S261. https://doi.org/10.1093/cid/ciw046

Uden, L., Barber, E., Ford, N., & Cooke, G. S. (2017). Risk of Tuberculosis Infection and Disease for Health Care Workers: An Updated Meta-Analysis. *Open Forum Infectious Diseases*, *4*(3), 1–7. https://doi.org/10.1093/ofid/ofx137

van der Westhuizen, H.-M., Dorward, J., Roberts, N., Greenhalgh, T., Ehrlich, R., Butler, C. C., & Tonkin-Crine, S. (2022). Health worker experiences of implementing TB infection prevention and control: A qualitative evidence synthesis to inform implementation recommendations. *PLOS Global Public Health*, *2*(7), e0000292. https://doi.org/10.1371/journal.pgph.0000292

Van Der Westhuizen, H. M., Kotze, K., Tonkin-Crine, S., Gobat, N., & Greenhalgh, T. (2020). Face coverings for covid-19: from medical intervention to social practice. *BMJ*, *370*. https://doi.org/10.1136/BMJ.M3021

von Delft, A., Dramowski, A., Khosa, C., Kotze, K., Lederer, P., Mosidi, T., Peters, J. A., Smith, J., van der Westhuizen, H. M., von Delft, D., Willems, B., Bates, M., Craig, G., Maeurer, M., Marais, B. J., Mwaba, P., Nunes, E. A., Nyirenda, T., Oliver, M., & Zumla, A. (2015). Why healthcare workers are sick of TB. *International Journal of Infectious Diseases*, *32*, 147–151. https://doi.org/10.1016/j.ijid.2014.12.003

Wahome, E., Makori, L., Gikera, M., Wafula, J., Chakaya, J., Edginton, M. E., & Kumar, A. M. V. (2013). *Tuberculosis treatment outcomes among hospital workers*. *I*(4), 323–327.

Wanyonyi, A. W., Wanjala, P. M., Githuku, J., Oyugi, E., & Kutima, H. (2017). *Supplement article Factors associated with interruption of tuberculosis treatment among patients in Nandi County , Kenya 2015*. *28*(Supp 1), 1–6. https://doi.org/10.11604/pamj.supp.2017.28.1.9347

Wasswa, P., Nalwadda, C. K., Buregyeya, E., Gitta, S. N., Anguzu, P., & Nuwaha, F. (2015). Implementation of infection control in health facilities in Arua district , Uganda : a cross-sectional study. *BMC Infectious Diseases*, 1–9. https://doi.org/10.1186/s12879-015-0999-4

Weyer, K., Mirzayev, F., Migliori, G. B., Van Gemert, W., D'Ambrosio, L., Zignol, M., Floyd, K., Centis, R., Cirillo, D. M., Tortoli, E., Gilpin, C., De Dieu Iragena, J., Falzon, D., & Raviglione, M. (2013). Rapid molecular TB diagnosis: Evidence, policy making and global implementation of Xpert MTB/RIF. *European Respiratory Journal*, *42*(1), 252–271. https://doi.org/10.1183/09031936.00157212

WHO. (2019). Guidelines on tuberculosis infection prevention and control 2019. In *Who* (Vol. 91, Issue 5). https://doi.org/10.1017/CBO9781107415324.004

Widyaningsih, V., Mulyaningsih, T., Rahmawati, F. N., & Adhitya, D. (2021). Original Research Abstract : Full Article : *Rural and Remote Health*, *21*(3), 1–

11.

World Health Organitation. (2023). Report 20-23. In *January: Vol. t/malaria/* (Issue March).

World Health Organization. (2009). *WHO Policy on TB Infection Control in Health-Care Facilities, Congregate Settings and Households*. 40. https://doi.org/WHO/HTM/TB/2009.419

World Health Organization. (2021). *WHO global lists of high burden countries for tuberculosis (TB), TB / HIV and TB (MDR / RR-TB)*. 2021–2025. http://apps.who.int/bookorders.%0Ahttps://cdn.who.int/media/docs/default-source/hq-tuberculosis/who_globalhbcliststb_2021-2025_backgrounddocument.pdf

Wouters, E., Rau, A., Engelbrecht, M., Uebel, K., Siegel, J., Masquillier, C., Kigozi, G., Sommerland, N., & Yassi, A. (2016). The Development and Piloting of Parallel Scales Measuring External and Internal HIV and Tuberculosis Stigma among Healthcare Workers in the Free State Province, South Africa. *Clinical Infectious Diseases*, *62*, S244–S254. https://doi.org/10.1093/cid/civ1185

Zumla, A., George, A., & Sharma, V. (2013). WHO's 2013 global report on tuberculosis: Successes, threats, and opportunities. *The Lancet*, *382*(9907), 1765–1767. https://doi.org/10.1016/S0140-6736(13)62078-4

APPENDICES

Appendix I: Consent form

Introduction

My Name is Janeffer Muthoni Wangari pursuing a Master's degree in Occupational Safety and Health (OSH). I am conducting a study on "**Compliance with Tuberculosis Infection, Prevention and Control Guidelines among Healthcare Workers in Kenyatta National Hospital and Mbagathi District Hospital**" I wish to request for permission from you to participate in this study. I am humbly requesting you to cooperate with me and provide the necessary accurate information. The results will be utilized by Ministry of Health to enforce the IPC guidelines in the healthcare facilities and among healthcare workers, ultimately contributing to global SDG 2030 END TB.

Procedures to be followed

Participation in this study will require that you are asked some questions targeting the level of your knowledge, attitude and practices in relation to the topic. You may ask questions related to the study for clarity. You have a right to refuse participation since is voluntary. You can as well choose not to answer any questions or withdraw from the interview without any consequences.

Discomforts and Risks

Some of the questions you asked may make you uncomfortable. Incase this happens, you may refuse to respond to these questions. You may also disengage from the interview at any moment. The interview will take roughly 30 minutes.

Benefits and rewards

If you participate in this study, you will help us to identify where there might be lapse of compliance to IPC guidelines and help reduce drastically the occupational TB among the healthcare workers and ultimately eradicating the disease in the community, we live in. If you will participate in this study there is no guaranteed monetary rewards from the study.

Confidentiality

The interviews will be conducted in hospital setting at respective departments/sections. Your identity will not be recorded anywhere. The provided information will only be used for the purpose of this research therefore will be treated with deserved confidentiality and privacy.

Contact Information

If you have any questions, you may contact 1. Janeffer Muthoni 0721 719395 2. Dr. Emmah Mwangi on 0724 165189 or 3. Dr Washington Arodi 0733 805224 or KNH-UoN ERC secretary on uonknh_erc@uonbi.ac.ke ; Tel no: 726300-9, Ext 44102 or the Kenyatta University Ethical Review Committee Secretariat on chairman.kuerc@ku.ac.ke

Participant's statement

The above information about my participation in the study is clear to me. I have been given an opportunity to ask questions and my questions have been responded to my satisfaction. My participation in this study is entirely voluntary. I understand that my records will be kept private and that I can leave the study at any time.

Code of

Participant……...

_____ _____

Signature or Thumbprint Date

Investigator's statement

I, the undersigned, have explained to the volunteer in a language she/se understands, the procedures to be followed in the study and the benefits and risks involved.

Name of

Interviewer…….

_____ _____

Interviewer signature ……

Date……

Appendix II: Respondent questionnaire

Name of the hospital/ health facility……

Healthcare worker Number/ID……

Job Title A. Nurse B. Laboratory staff C. Nursing Student D. Medical student

SECTION 1: SOCIO-DEMOGRAPHIC DATA

1. Age----------
2. Gender A. Female ☐ B. Male ☐
3. Marital status
   1. Single ☐ 2.Married ☐
   3. Divorced ☐ 4.Widowed ☐ 5.Separated ☐
4. Level Of education
   1. Certificate ☐ 2. Diploma ☐
   3. Higher Dip ☐ 4. Bachelors ☐ 5. Masters ☐
5. How long have you worked in the healthcare set-up?
   1. 0-2yrs ☐ 3-5yrs ☐ Above 5yrs ☐
6. How many hours do you work per shift?
7. Do you hold continuous medical education on TB IPCs? Yes or NO

   If yes, how often?
8. Salary received per month
   1. < Kshs 30,000 ☐ 2. Kshs 30,001-50,000 ☐

4. Kshs 50,001-100,000 ☐ 5. Above Ksh 100,000 ☐

☐

6. Not applicable

9. Have you had some training on TB IPC for the last six months? Yes or No

SECTION 2: TUBERCULOSIS KNOWLEDGE (symptoms, transmission, diagnosis, prevention and treatment)

10. The following questions relate to Tuberculosis knowledge in terms of transmission, diagnosis, prevention and treatment. Please circle the response that best describe your own opinion

Statement	Respondent knowledge response (Correct/Wrong)
Symptoms of TB	
Chronic cough	Correct
Night sweat	Correct
Weight loss	Correct
High fever	Correct
Transmission	
TB is transmitted through Inhalation of the bacilli	Correct
TB is contagious	Correct
Lungs is not the primary target site for TB	Wrong
Diagnosis	
Sputum examination is a major TB diagnostic tool	Correct
Prevention	
BCG vaccination prevents contracting TB	Correct
HIV/AIDS is a pre-disposing factor in contracting TB	Correct

TB persons with negative sputum tests are considered non-infectious	Wrong
N95 masks is not necessary in TB prevention	Wrong
Surgical mask protects against TB	Wrong
Tissues and surgical masks should be given to patients coughing	Correct
Natural ventilation is vital in TB prevention	Correct
TB suspects should be separated from other patients not coughing	Correct
TB suspects should be made to wait on queue like any other patient	Wrong
Coughing patients should be placed in isolated waiting bay	Correct
Prompt diagnosis and treatment is key in eradicating TB	Correct
A HIV positive worker can prevent TB infection through TB IPC strategies	Correct
A HIV positive worker should avoid high-risk areas	Correct
Treatment	
Active TB is curable	Correct
Isoniazid Therapy protects HIV persons from developing TB	Correct
TB treatment takes six months	Correct

SECTION 3: ATTITUDE OF HEALTH CARE WORKERS

The following questions are to measure the attitude of healthcare workers in relation to Tuberculosis.

11. Is TB just like any other disease you deal with in the facility? Yes or No

If no, explain.....

12. What would your reaction be if the TB patient requested to seek traditional healer for cure?

13. Please circle the response that best describes your view or opinion.

	Yes	No
Are you afraid of acquiring TB?		
Have you had any training of TB IPC that makes you comfortable in handling TB patients?		
Do you have any health concerns when it comes to working with TB patients?		
Are there any local believes that you know that may make patients not seek help in hospital or adhere to treatment?		
Respirators are uncomfortable and therefore I prefer not to use in line of duty.		
Is there any need for HCWs exposed to TB patients undergo TB screening?		
Cough etiquette has no role in TB IPC.		
I am at higher risk of developing TB if I am HIV positive.		

SECTION 4: PRACTICES OF HEALTH CARE WORKERS

14. The following are self-reported TB IPC meant to analyze the practices of the HCWs in the hierarchy control measures.

	Yes	No
Administrative measures		
Do you ask the patients if they are coughing and how long?		
Do you isolate those who have been coughing?		
Do you put those coughing in front of the queue thus minimizing their		

waiting time?		
Do you provide tissues or surgical masks to those coughing?		
Do you order sputum test on suspected TB persons?		
Do you educate patients on cough etiquette? Circle one if yes (Always, Never, sometimes, As per the need)		
Environmental measures		
Do you keep the window open to increase ventilation?		
Do you explain the importance of keeping windows open to the patients?		
Do you ensure negative pressure within the high-risk area?		
Do you turn off fans when very noisy or/and cause cold air to blow around?		
Personal Protective Equipment		
Do you use N-95 respirator while consulting or interacting with patients?		
Do you use N-95 respirator in sputum handling?		

Appendix III: Observation Checklist

PART 1: ADMINISTRATIVE MEASURES

1. Any adequate supplies for observing hygiene hence reduction of TB infection (soap, running water and paper/hand towel?
   - Running water only Yes No
   - Soap only Yes No
   - Soap and running water Yes No
   - Any hand towel? Yes No
2. Any provision of IEC materials written on TB within the facility where patients can see?

   Yes No
3. Patients with a cough are identified on arrival at the facility, given guidance on cough etiquette, separated from other patients and fast-tracked through all waiting areas, including consultation, investigations and drug collection.

   Yes No
4. Supplies are readily available for coughing patients (tissues, surgical masks, cloths) and are being used, and there are medical waste bins for safe disposal.

   Yes No
5. TB information for patients is readily available and offered by staff.

   Yes No
6. Waiting areas for HIV services physically separated from the waiting area for TB patients?

Yes ☐ No ☐

7. Designated area for sputum collection?

   Yes ☐ No ☐

   If yes, is it clearly marked for patients' easy accessibility?

PART 2B: PERSONAL RESPIRATORY PROTECTION (PRP) MEASURES

8. Provision of facemasks for patients' coughing

   Yes ☐ No ☐

9. Availability of non-touch waste disposal receptacles at the waiting area

   Yes ☐ No ☐

10. Provision of health education on cough hygiene

    Yes ☐ No ☐

11. Display of posters on cough etiquette

    Yes ☐ No ☐

12. Segregation of TB suspects/ cases

    Yes ☐ No ☐

13. Type of respirator used.

    - N95mask
    - Surgical mask
    - Ordinary mask

14. Availability of N95 respirators on HCWs

    Yes ☐ No ☐

    If yes, which proportion of shift wore the respirator? (Circle the appropriate)

    - <25%

- 26-50%
- 51-75%
- >75%

15. Do we have isolation rooms and if yes are they adequate?

    Yes ☐ No ☐

16. Do we have sinks in consultation rooms?

    Yes ☐ No ☐

    If yes, any running water?

PART 3: VENTILATION

17. Circle the appropriate one.

    - Completely open
    - Open windows and doors
    - Closed window and doors
    - Open window and closed doors

18. Sticker on “open window” observed and complied with?

    Yes ☐ No ☐

19. Fans observed and switched on?

    Yes ☐ No ☐

    If yes, which section/department?.....

    Are they clean and functional?

    Yes ☐ No ☐

20. The Ultra violet lights observed and switched on?

    Yes ☐ No ☐

    If yes, which section/department?.....

21. Filtration units observed and switched on?

Yes ☐ No ☐

If yes, which section/department?.....

22. Adequacy of window/floor ratio in the waiting area.

Yes ☐ No ☐

23. Adequacy of window/floor ratio in the consulting rooms.

Yes ☐ No ☐

Appendix IV: Key Informant Interview's Guide

Guiding questions for KII

1. How is the health support within your department/facility in terms of the following aspects? Namely;

    a) TBIC leadership

    - Do we have TBIC committee in place?
    - Who chairs and how often do they meet?
    - What measures has been put in place to ensure participation/shared responsibility among HCWs?
    - Any risk assessment carried out and how often?
    - Any monitoring and evaluation done to measure HCWs behavior change not necessarily the knowledge acquisition?

    b) Resource Availability

    - Do you feel that the management is doing enough/committed in supporting the TBIC protocols in terms of infrastructure (e.g. sink and running water), consumables (e.g. soap, alcohol and hand towels) among others in curbing occupational TB among HCWs?
    - What would you suggest be done differently for a better outcome?

    c) Operational Policies

    What are some of the policies the facility has put in place in regard to TBIC implementation?

i. **Regular screening of HCWs of TB**

How often and how are the positives cases handled? Do we keep the statistics of the positive HCWs?

ii. **Confidential HIV testing and counselling system for HCWs**

Any privileges/consideration for the seropositive HCWs e,g not posted in TB risk areas?

iii. **Open Window Policy**

iv. **Maximum natural ventilation policy**

v. **Facility TBIC specific policy/SOPs**

- Do we have them properly displayed on walls e.g. of waiting areas in form of posters?
- Are they in a language the patients can understand with ease?
- Ward restriction and minimization of visitors

vi. **PPEs issuance policy**

- Any fit-testing done on respirators and do the HCWS know how to carry out the test themselves?
- Any guidelines on maintenance, storage and replacement?
- How accessible and fast is the compensation process?

vii. **In-service and refresher trainings**

- How often are the training held?

- Has it shown any behavioral change among HCWs in implementing the TBIC?

d) **Human capital including collaboration with other relevant stakeholders**.

- What is the acceptable threshold of workload, staffing and bed occupancy and do we keep to it?
- Any other relevant stakeholders on board and what is their role?

2. Engineering Measures

How often are the machines, apparatus or equipment disinfected/ maintained and/or inspected? Such as HEPA filters, germicidal UV lights, hood/fume chambers etc.

3. What are the perceptions of HCWs toward the TBIC implementation?

- Any non-compliance that has been observed in the past? What could be the reason and what measures have you taken to ensure compliance?
- What are the main barriers towards the implementation and what are the mitigation measures being put in place?
- Any recognition and disciplinary measures in place?

Appendix V: Research approval from Kenyatta University Graduate School

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Dean, Graduate School

DATE: 3rd May, 2019

TO: Ms. Janeffer Muthoni Wangari
C/o Department of Environmental
& Occupational Health

REF: Q22/CTY/PT/37404/2017

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

We acknowledge receipt of your Research Proposal after fulfilling recommendations raised by the Graduate School Board of 27th March, 2019.

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation and Ethics Review Committee, Kenyatta University.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking Forms per semester. The form has been developed to replace the Progress Report Forms. The Supervision Tracking Forms are available at the University's Website under Graduate School webpage downloads.

Thank you.

15 MAY 20..

EDWIN OBUNGU
FOR: DEAN, GRADUATE SCHOOL

CC. Chairman, Department of Environmental & Occupational Health

Supervisors:

1. Dr. Emmah Mwangi
   C/o Department of Environmental & Occupational Health
   Kenyatta University

2. Dr. Washington Arodi
   C/o Department of Medical Laboratory Science
   Kenyatta University

SO/cww

Appendix VI: Research authorization from Kenyatta University Graduate

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Our Ref: Q22/CTY/PT/37404/2017 DATE: 3rd May, 2019

Director General,
National Commission for Science, Technology
and Innovation
P.O. Box 30623-00100
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR MS. JANEFFER MUTHONI WANGARI – REG. NO. Q22/CTY/PT/37404/17

I write to introduce Ms. Janeffer Muthoni Wangari who is a Postgraduate Student of this University. She is registered for M.Sc. degree programme in the Department of Environmental & Occupational Health.

Ms. Wangari intends to conduct research for a M.Sc. thesis Proposal entitled, "Compliance with Tuberculosis Infection, Prevention and Control Guidelines among Healthcare Workers in Kibera, Nairobi City County, Kenya."

Any assistance given will be highly appreciated.

Yours faithfully,

KENYATTA UNIVERSITY OFFICE OF DEAN 15 MAY 2019 GRADUATE SCHOOL P.O. Box 43844-00100 NAIROBI

for

PROF. ELISHIBA KIMANI
DEAN, GRADUATE SCHOOL

ED/sww

Appendix VII: Ethicals clearance from Kenyatta University ethical and review committee

KENYATTA UNIVERSITY
ETHICS REVIEW COMMITTEE

Fax: 8711242/8711575
Email: kuerc.chairman@ku.ac.ke

Website: www.ku.ac.ke

P. O. Box 43844,
Nairobi, 00100
Tel: 8710901/12

Our Ref: **KU/ERC/ APPROVAL/VOL.1 /277**

Date: 15th July, 2019

Janeffer Muthoni Wangari
P.O Box 43844, 00100
Nairobi.

Dear, Ms. Wangari

APPLICATION NUMBER: PKU/1033/I1083 COMPLIANCE WITH TUBERCULOSIS INFECTION, PREVENTION AND CONTROL GUIDELINES AMONG HEALTHCARE WORKERS IN KIBERA, NAIROBI CITY COUNTY, KENYA

1. **IDENTIFICATION OF PROTOCOL**

The application before the committee is with a research topic **"Compliance with Tuberculosis Infection, Prevention and Control Guidelines among Healthcare Workers in Kibera, Nairobi City County, Kenya"**. Received on 8th May, 2019 and discussed on 11th June, 2019

2. **APPLICANT**

Janeffer Muthoni Wangari

3. **SITE**

Kibera, Nairobi City County, Kenya

4. **DECISION**

The committee has considered the research protocol in accordance with the Kenyatta University Research Policy (section 7.2.1.3) and the Kenyatta University Ethics Review Committee Guidelines and **APPROVED that the research may proceed for a period of ONE year from 11th June, 2019.**

Appendix VIII: Research permit from National Commission for Science, Technology and Innovation

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **586236**

Date of Issue: **23/August/2019**

RESEARCH LICENSE

This is to Certify that Miss.. Janeffer Wangari of Kenyatta University, has been licensed to conduct research in Nairobi on the topic: COMPLIANCE WITH TUBERCULOSIS INFECTION,PREVENTION AND CONTROL GUIDELINES AMONG HEALTHCARE WORKERS IN KIBERA ,NAIROBI CITY COUNTY, KENYA for the period ending : 23/August/2020.

License No: **NACOSTI/P/19/429**

586236

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix IX: Ethicals clearance from Kenyatta National Hospital ethical and review committee

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

KENYATTA NATIONAL HOSPITAL APPROVED 11 OCT 2019 KNH/UoN-ERC P. O. BOX 20723 - 00202 NAIROBI

Ref: KNH-ERC/A/380

11th October, 2019

Janeffer Muthoni Wangari
Reg. No.Q22/CTY/PT/37404/2017
Department of Environmental and Occupational Health
School of Public Health
Kenyatta University

Dear Janeffer

RESEARCH PROPOSAL: COMPLIANCE WITH TUBERCULOSIS INFECTION, PREVENTION AND CONTROL GUIDELINES AMONG HEALTHCARE WORKERS IN KENYATTA NATIONAL HOSPITAL AND MBAGATHI DISTRICT HOSPITAL (P646/07//2019)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and **approved** your above research proposal. The approval period is 11th October 2019 – 10th October 2020.

This approval is subject to compliance with the following requirements:

a. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
c. Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e. Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
f. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
g. Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

NAIROBI CITY COUNTY

Tel: 2724712, 2725791, 0721 311 808
Email: mbagathihosp@gmail.com

Mbagathi Hospital
P.O. Box 20725- 00202
Nairobi

COUNTY HEALTH SERVICES

Ref: MDH/RS/1/VOL.1

1st October 2019

Jennifer Muthoni
Kenyatta University

RE: RESEARCH AUTHORIZATION

This is in reference to your application for authority to carry out a research on *"Compliance with Tuberculosis infection, prevention and control guidelines among healthcare in Mbagathi Hospital "*

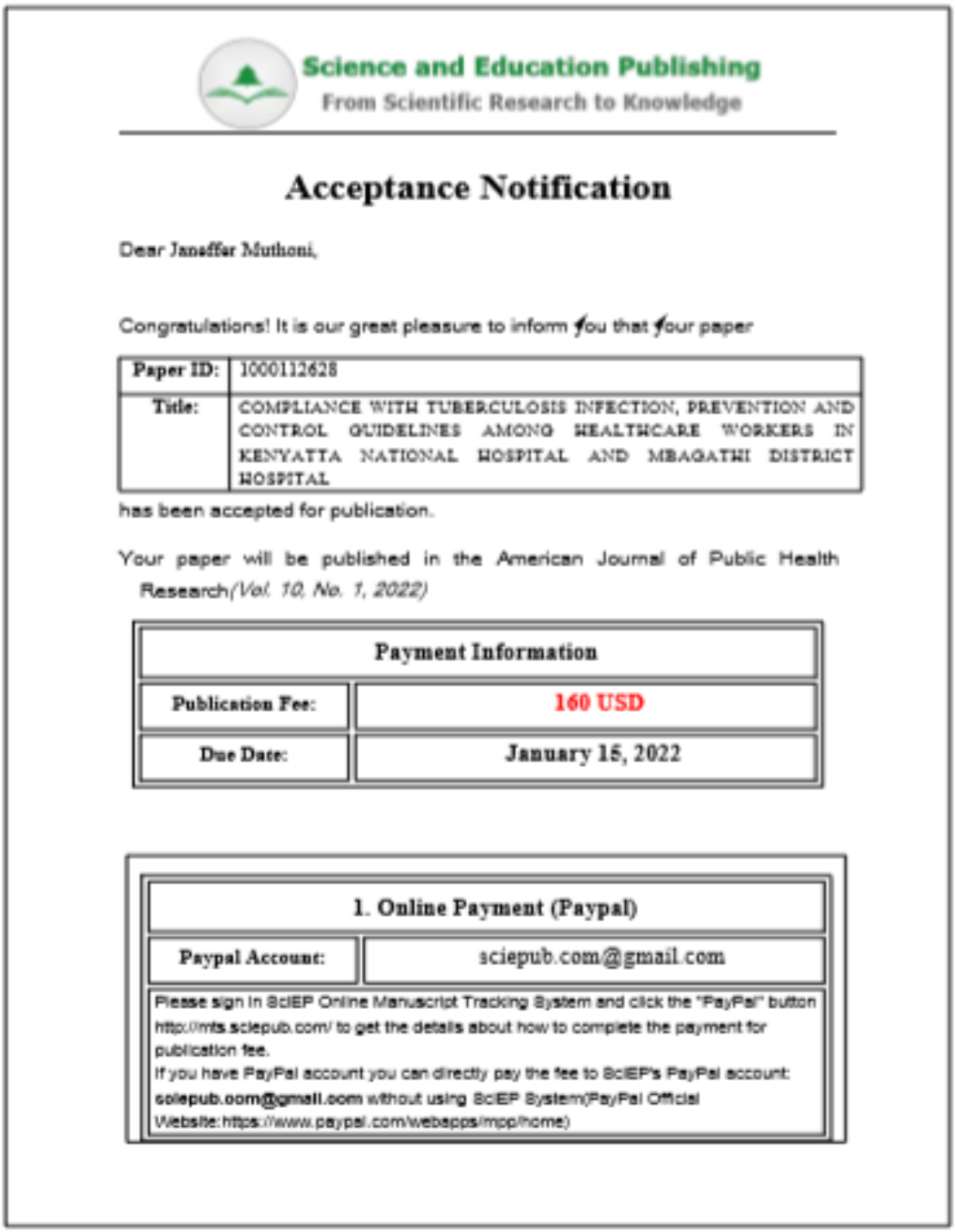
I am pleased to inform you that your request to undertake the research in the hospital has been granted.

On completion of the research you are expected to submit one hard copy and one soft copy of the research report / thesis to this office.

MBAGATHI COUNTY HOSPITAL
01 OCT 2019
TEL: 0721 311 808
P.O. Box 20725 - 00202, NAIROBI

Phillip Mibei
For: Chairman – Research Committee
Mbagathi Hospital

Appendix XI: Abstract of the publication



Science and Education Publishing
From Scientific Research to Knowledge

Acceptance Notification

Dear Janeffar Muthoni,

Congratulations! It is our great pleasure to inform you that your paper

Paper ID:	1000112628
Title:	COMPLIANCE WITH TUBERCULOSIS INFECTION, PREVENTION AND CONTROL GUIDELINES AMONG HEALTHCARE WORKERS IN KENYATTA NATIONAL HOSPITAL AND MBAGATHI DISTRICT HOSPITAL

has been accepted for publication.

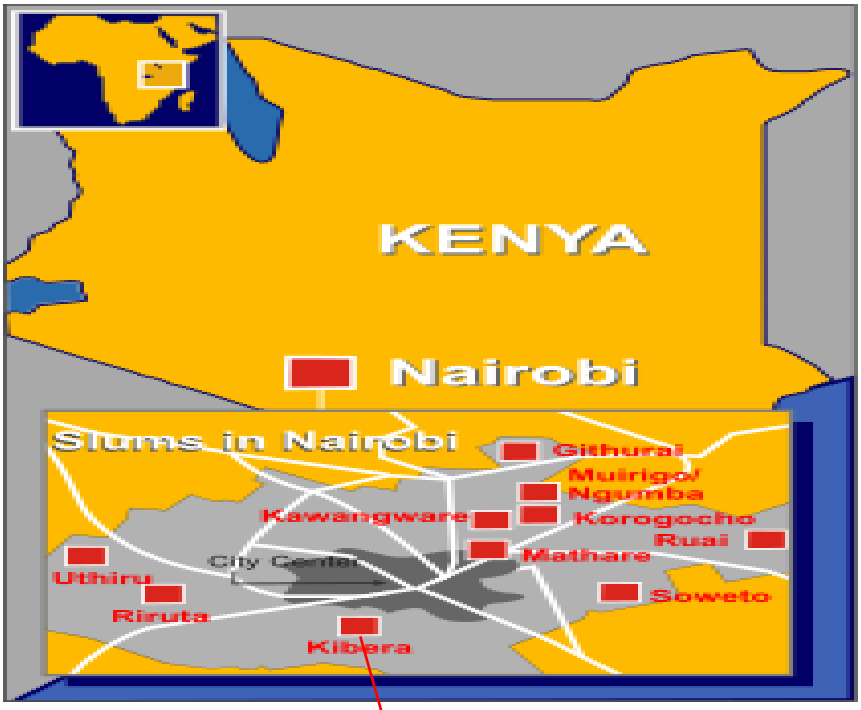
Your paper will be published in the American Journal of Public Health Research*(Vol. 10, No. 1, 2022)*

Payment Information	
Publication Fee:	**160 USD**
Due Date:	**January 15, 2022**

1. Online Payment (Paypal)	
Paypal Account:	sciepub.com@gmail.com

Please sign in SciEP Online Manuscript Tracking System and click the "PayPal" button http://mts.sciepub.com/ to get the details about how to complete the payment for publication fee.
If you have PayPal account you can directly pay the fee to SciEP's PayPal account: **sciepub.com@gmail.com** without using SciEP System(PayPal Official Website: https://www.paypal.com/webapps/mpp/home)

Appendix XII: Map of study location



Government hospitals within the Lang'ata Subcounty