SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA

KNOWLEDGE AND PRACTICE OF TUBERCULOSIS INFECTION PREVENTION AND CONTROL MEASURES AMONG NURSES AND DOCTORS IN SELECTED GOVERNMENT HOSPITALS IN ACCRA, GHANA

BY

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THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PUBLIC HEALTH DEGREE

JULY, 2019

DEC LARATION

I, Esther Amene Osei-Yeboah declare that except for other people's investigations which have been duly acknowledged, this dissertation is the result of my own original research, undertaken under supervision and that it has neither in whole nor in part been presented for another degree in this university or elsewhere.

Date 23/10/19

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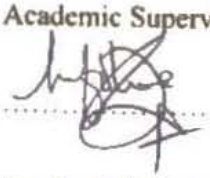

Date 23/10/19

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DEDICATION

This dissertation is dedicated to my family

ACKNOWLEDGEMENT

I thank the Lord Almighty for His provision, strength, and grace throughout the duration of this project. I also thank my supervisor, Dr. Paul Kingsley Botwe for his supervision and immense support. I am also grateful to the entire faculty of the School of Public Health for their diverse contribution towards this project.

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ABSTRACT

Tuberculosis (TB) is a major occupational hazard in resource limited healthcare settings. Owing to this, the World Health Organization (WHO) has suggested the adoption and implementation of Tuberculosis Infection Prevention and Control (TBIPC) programs in all healthcare facilities. However, studies have reported improper implementation and practice of these TBIPC measures in healthcare facilities in developing countries. Thus, this study examined the knowledge and practice of TBIPC measures among nurses and doctors at Achimota, La General, Greater Accra Regional and Princess Marie Louise Children's hospitals in the Accra Metropolis. The study was cross-sectional and data was collected by the administration of questionnaire. Using a proportionate stratified sampling, 403 doctors and nurses were selected from these government hospitals. Bivariate analyses and a multiple logistic regression were used to examine the most important predictors of TBIPC. Overall, the results showed that, the proportion of nurses and doctors with effective TBIPC practices was 27.1%. This suggests that nurses and doctors in these selected hospitals may be at increased risk of nosocomial transmission of TB. Additionally, educational level (AOR 2.87; 95% CI=1.182-7.832), number of years worked (AOR= 1.93; 95% CI=1.03-10.107), knowledge about TBIPC (AOR= 2.23; 95% CI=1.671-7.428), and ever attended TBIPC training (AOR= 0.18; 95% CI = 0.011-0.630) were found to predict TBIPC practices. Therefore, the Ministry of Health should conduct TBIPC training as well as provide resources and logistics in government health facilities to promote effective practice of TBIPC measures.

Keywords: tuberculosis infection prevention and control, knowledge, practice, nurses, doctors, healthcare facilities

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AIDS	Acquired immunodeficiency virus
CDC	Centre for Disease Control
DR-TB	Drug-resistant tuberculosis
ERC	Ethics Review Committee
EPTB	Extra pulmonary tuberculosis
HCWs	Health care workers
HIV	Human immunodeficiency virus
IPC	Infection prevention and control
LTBI	Latent TB infection
MDR-TB	Multi-drug resistant TB
PH	Public Health
PI	Principal Investigator
PLWHA	People living with HIV/AIDS
PPE	Personal Protective Equipment
PTB	Pulmonary tuberculosis
TB	Tuberculosis
TBIPC	Tuberculosis infection prevention and control
WHO	World Health Organization
XDR-TB	Extensively drug resistant tuberculosis

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CHAPTER ONE

INTRODUCTION

1.1 Background

Tuberculosis (TB) is among the top ten (10) causes of death globally and the leading cause of death from a single contagious organism (Segar & Reuters, 2018), with strains of *Mycobacterium tuberculosis* spreading through contagious droplets aerosolized by persons with active pulmonary TB (PTB) (von Delft et al., 2015). There has been reported cases of higher rates of nosocomial transmission of TB among healthcare workers (HCWs) in several countries, especially in developing countries such as Ghana (Shrestha et al., 2017), with HCWs being twice at risk of contracting tuberculosis from patients than the general population (Demissie Gizaw et al.,2015). Despite this, the problem of spread of TB infection from patients to HCWs is however overlooked in these developing countries.

TBIPC is a combination of interventions targeted at minimizing the risk of nosocomial TB transmission (Lipke et al., 2016). These measures are ; Administrative controls which includes triaging, separation or isolation of people with presumed infectious TB, prompt initiation of TB treatment for confirmed cases , respiratory hygiene (including promotion of cough etiquette) in people with presumed or confirmed TB; Environmental controls which includes use of upper-room germicidal ultraviolet systems and ventilation systems (natural, mixed-mode, mechanical ventilation and recirculated air through high-efficiency particulate air filters); Respiratory protection which is provision of particulate respirators and training of HCWs on components of the respiratory protection program (WHO, 2019). However, given their high cost, these important measures are instituted by health care facilities in high income countries, with only a few facilities in the developing countries (e.g. Ghana) implementing them. Thus, there is the need for studies

that will examine our current TBIPC practices in our hospitals. Such studies will inform management decisions aimed at improving TBIPC practices in Health Care Centers in Ghana.

The study area in Accra, Ghana comprises of Achimota Hospital, Princess Marie Louise Children's Hospital, Greater Accra Regional Hospital and La General Hospital. These are the four main government hospitals responsible for provision of health care to majority of the populace in the Accra Metropolis. This study examined the knowledge and practice of TBIPC measures among nurses and doctors in these selected government hospitals in the Accra Metropolis.

1.2 Problem Statement

Globally, TB is a major occupational hazard in healthcare settings (von Delft et al., 2015) and has been reported to result in significant morbidity and mortality among HCWs in developing countries (Lipke et al., 2016). It is approximated that over 50% of HCWs worldwide have latent TB infection (Tudor et al., 2014). The estimated incidence of TB in Ghana in 2016 was 156 / 100,000 population with 23% living with HIV as well (Jackson, 2018), however, there is no published data of the incidence among HCWs in Ghana. The risk of TB transmission has significantly increased as a result of the emergence of strains of resistant *Mycobacterium tuberculosis* and comorbidity with HIV (Ghana Health Service, 2010). This risk is immense when prolonged exposure is associated with inadequate infection prevention and control (IPC) measures (Tamir et al., 2016). Even though HCWs and important stakeholders are knowledgeable about risk of nosocomial TB transmission, there is poor implementation and practice of TBIPC measures in most health facilities (Demissie Gizaw et al., 2015). The principal investigator (PI) with eight (8) years working experience at the Chest Unit of Korle-Bu Teaching Hospital has over the years observed poor implementation and practice of TBIPC measures. Again, the PI has over the years

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observed that HCWs who reported to the Chest Unit with TB disease were from non-specialized TB wards with none or poor implementation and practice of TBIPC measures.

1.3 Justification

The risk of occupational exposure to TB has been reported to be on the increase in a variety of resource limited countries, mostly as a result of improper and inefficient implementation of TBIPC measures (Mirtskhulava et al., 2016). All HCWs including biomedical scientists, health care assistants, community health workers and health science students are at risk but the risk is greater among nurses and doctors (Oxley et al., 2018). Close contact with an infectious case before diagnosis of TB disease is a major factor contributing to occupational transmission of TB (Demissie Gizaw et al., 2015). These undiagnosed TB cases are sometimes admitted and managed together with non-TB cases on non-specialized TB wards repeatedly exposing health workers to TB infection (Tenna et al., 2013). To counter the risk of occupational TB transmission, the World Health Organization (WHO) has suggested the adoption and implementation of TBIPC measures but several studies persistently depict the absence of TBIPC programs as well as improper implementation in health care facilities in developing countries (Oxley et al., 2018). This study therefore sought to provide data on the TBIPC practices among nurses and doctors for assessment, intervention, monitoring, and evaluation purposes which may ultimately curb the problem of occupational TB transmission.

1.4. Research Questions

1. What is the knowledge level of nurses and doctors on TBIPC measures?
2. What is the proportion of nurses and doctors with effective TBIPC practices?
3. What are the factors influencing TBIPC practices among nurses and doctors?

1.5 Study Objectives

1.5.1 General Objective

To examine the knowledge and practice of TBIPC measures among nurses and doctors at selected government hospitals in the Accra Metropolis.

1.5.2 Specific Objectives

1. To assess the knowledge level of nurses and doctors on TBIPC measures.
2. To determine the proportion of nurses and doctors with effective TBIPC practices.
3. To determine the factors that influence TBIPC practices among nurses and doctors.

1.6 Conceptual framework

Figure 1 is a framework depicting the relationship between associated factors and the practice of TBIPC measure among HCWs. Institutional settings such as healthcare facilities, are noted to significantly contribute to the risk of TB transmission (Shrestha et al., 2017). Thus, the need for the adoption and implementation of TBIPC measures by healthcare facilities to promote the practice of TBIPC measures among HCWs to curtail the risk of nosocomial transmission of TB. Demographic characteristics such as level of education, sex, profession, age, marital status and years of experience affect the individual's attitude towards TBIPC practice. Adequate knowledge of TBIPC measures by HCWs also influences the practices of TBIPC measures although knowledge in the absence of proper implementation of the TBIPC measures leads to poor practices (Chadha et al., 2012). Again, frequent training on TBIPC measures empowers HCWs to take the necessary precautions to protect themselves from occupational TB transmission (Kumar & Deka, 2010).

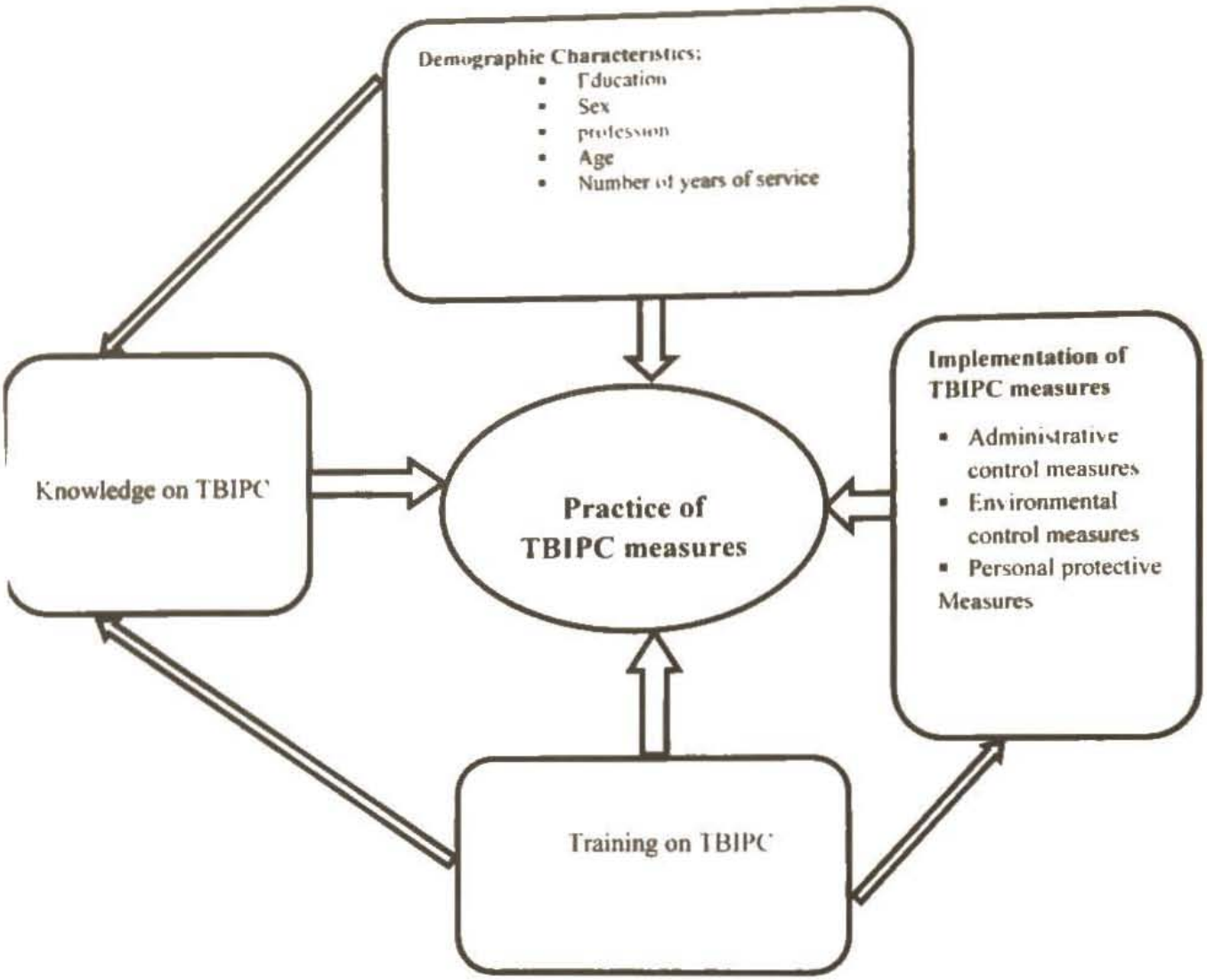

Figure 1: Conceptual Framework for Factors Affecting TB Infection Prevention and Control Practices.

CHAPTER TWO

LITERATURE REVIEW

2.1 Global Epidemiology of TB

TB is caused by species of *Mycobacterium* which are rod shaped, non-spore-forming, aerobic bacterium (Knechel, 2009). Two species of *Mycobacterium* cause TB: *Mycobacterium tuberculosis* which is transmitted by inhalation of infective droplets coughed or sneezed into the air by the patients with active TB and *Mycobacterium bovis* which is transmitted by milk from diseased cows (Kumar & Deka, 2010).

There are two types of clinical manifestations of TB: pulmonary TB (PTB) involving the lungs and extra pulmonary TB (EPTB) involving other organs such as the pleura, lymph nodes, abdomen, skin, meninges, joins and bones and genitourinary tract. TB is contagious when it occurs in the lungs (Demissie Gizaw et al., 2015). The disease is airborne, with breathing being the main risk activity (Oxley et al., 2018). Chronic cough, sputum production, night sweats, hemoptysis, weight loss, fever and anorexia are distinctive clinical features of PTB (Reyn, 2013). Infection with TB bacteria results in two (2) TB related conditions: active TB disease (symptomatic and infectious) and latent TB infection (LTBI) (asymptomatic and non-infectious) (Respir, 2000).

Multidrug-resistant TB (MDR-TB) is a form of *Mycobacterium tuberculosis* strain resistant to Rifampicin and or Isoniazid which constitute the major drugs of the first line of treatment of TB in combination with Pyrazinamide and Ethambutol (Atipo-tsiba et al., 2017). There is increased risk of transmission of TB as a result of the emergence of resistant strains of *Mycobacterium tuberculosis* and comorbidity with HIV (Ghana Health Service, 2010). Globally, an estimated 1.7 billion people have LTBI, and may develop active TB disease during their lifetime (Segar &

Reuters, 2018). Over 50% of HCWs worldwide are estimated to have LTBI, however, there is not much documentation on the burden of active TB disease among HCWs (Tudor et al., 2014). A meta- analysis estimated that globally, the average annual risk of contracting TB disease for HCWs was three (3) times higher (95% confidence interval 2.43- 3.51) compared to the general public (von Delft et al., 2015). Comorbidity of TB and HIV infection in sub-Saharan Africa pose a serious challenge to health delivery (McCarthy et al., 2015). In these settings, HCWs are again affected by drug-resistant TB (DR-TB) at a greater frequency than the communities they serve (Oxley et al., 2018). The first data on the global emergence of extensively drug resistant TB (XDR-TB), which is resistance to second-line drugs was published in March 2006 (Kumar & Deka, 2010).

2.2 Global burden of TB

TB remains a major Public Health (PH) issue worldwide (Heuvelings et al., 2017). Currently, TB is the leading cause of death from a contagious disease globally, surpassing HIV and Malaria (Oxley et al., 2018). Approximately ten (10) million people worldwide were diagnosed of TB disease in 2017 (Segar & Reuters, 2018). About four (4) million persons develop active TB and 650,000 people die each year in Africa (Demissie Gizaw et al., 2015). Worldwide, HCWs are at increased risk for TB infection and disease, however, rates of occupationally acquired TB are highest in developing countries (Oxley et al., 2018). A systematic review of TB incidence in developing countries approximated that annually, the risk of TB infection in HCWs ranges from 3.9% to 14.3% (with between 2.6% and 11.3% due to occupational exposure) (von Delft et al., 2015). In China, TB incidence in HCWs is 985 per 100,000 population (Du et al., 2017). In sub-Saharan Africa, about 25% of preventable deaths and transmission of MDR-TB among people living with HIV/AIDS (PLWHA) in hospitals have been recorded with high mortality rates (Demissie Gizaw et al., 2015). In Uganda, scholarly works have reported a high burden of TB with

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a prevalence of 57 % for LTBI and 1.7 % compared to 0.3 % for active TB among HCWs compared to the general population (Buregyeya, Kasasa, & Mitchell, 2016). Ethiopia has 210 cases per 100,000-population TB prevalence with 44 cases per 100,000-mortality rate making it one of the 22 high TB burden countries. (Demissie Gizaw et al., 2015). Ethiopia is also one of the 27 high MDR-TB burden countries in the world (Shrestha et al., 2017). Surveys among HCWs in South Africa have reported that up to 16% of HCWs in South Africa are living with HIV, greatly predisposing them to occupational TB (Tudor et al., 2014). Compounded with HIV/AIDS, TB has become a formidable threat to South Africa (Tamir et al., 2016).

The estimated incidence of TB in Ghana in 2016 was 156 / 100,000 population with 23% living with HIV as well (Jackson, 2018) There is however no published data on nosocomial transmission of TB among HCWs in Ghana.

2.3 Factors contributing to occupational transmission of TB

HCWs are susceptible to nosocomial TB as a result of poor implementation and practice of TBIPC measures (Temesgen & Demissie, 2014). Delayed diagnosis and ineffective treatment of TB patients contribute significantly to occupational transmission of TB (Buregyeya et al., 2016). Persistent occupational TB exposure associated with a high prevalence of undiagnosed TB in healthcare facilities also predisposes HCWs to TB (Tamir et al., 2016). Furthermore, HCWs who are practicing without adequate training on TBIPC are at a serious disadvantage since they lack knowledge (Shrestha et al., 2017). Studies have reported lack knowledge of HCWs about TBPIC measures, as a factor which also greatly increases the risk of nosocomial transmission (Buregyeya et al., 2016). Poor ventilation and overcrowding in hospitals with people with infectious but undiagnosed TB cases may also account for a high proportion of TB transmission among HCWs (Oxley et al., 2018). The HIV epidemic as well as the emergence of MDR-TB and XDR-TB have

also been reported to be factors that facilitate the transmission of occupational TB in healthcare settings (Engelbrecht et al., 2016). In South Africa, lack of knowledge of TBIPC plans and guidelines and poor administrative participation in implementation of local TBIPC policy are reasons for the high incidence of nosocomial transmission of TB (Oxley et al., 2018).

2.4 TBIPC strategies

The goal of TBIPC measures is to reduce the spread of TB infection (Temesgen & Demissie, 2014). According to WHO 2019, the WHO initially proposed recommendations on TBIPC targeted at reducing nosocomial transmission of TB in resource limited settings. The recommendations were then updated in 2009 to provide further guidance on the use of specific measures for health care facilities, congregate settings and households. After the 2009 guidelines had been in effect for a decade, they were perused to provide an amended evidence based assessment, augmenting previous recommendations and linking to core components of effective IPC programs overall. The TBIPC measures are categorized into the following: Administrative control measures, environmental control measures and personal protective measures. Administrative controls is the first and most important component of the TBIPC strategy and it involves leadership's commitment to establish and implement IPC policies in health facilities (WHO, 2019). These measures include the following;

- Triage of individuals presenting with signs and symptoms TB, or with TB disease.
- Respiratory separation or isolation of people with presumed or demonstrated infectious TB.
- Prompt initiation of effective TB treatment of people with TB disease.
- Respiratory hygiene (including cough etiquette) in people with presumed or confirmed TB.

The Environmental control measures include the following;

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The Environmental control measures include the following:

- Upper-room germicidal ultraviolet systems which are recommended to reduce transmission of TB to health workers, persons attending health care facilities or other persons in settings with a high risk of transmission.
- Ventilation systems including natural, mixed-mode, mechanical ventilation and recirculated air through high-efficiency particulate air filters are recommended to reduce TB transmission to health workers, persons attending health care facilities or other persons in settings with a high risk of transmission.

Personal protective measures include the following:

- Particulate respirators, within the framework of a respiratory protection program, are recommended to reduce transmission of TB to health workers, persons attending health care facilities or other persons in settings with a high risk of transmission.
- Training of HCWs on components of the respiratory protection program.

To safeguard the health of HCWs, these measures should be embraced and vigorously implemented (Oxley et al., 2018).

2.5 Knowledge on TBIPC measures

A thorough knowledge of how TB is transmitted is very critical for the implementation and practice of TBIPC measures (Steinberg, 2014). Poor knowledge among HCWs on TBIPC measurees may lead to the increased risk of nosocomial TB transmission (Shrestha et al., 2017). In an assessment of the knowledge and practice of tuberculosis infection control among health professionals in Northwest Ethiopia, Temesgen & Demissie (2014) reported that the overall proportion of health professionals with good knowledge about TBIPC was 63.2%. Mirtskhulava et al., (2016) found a positive correlation between knowledge and practice of TBIPC measures among doctors and nurses, however, significant knowledge difference was discovered when

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professional category was analyzed. Doctors had higher scores compared to laboratory staff, nurses, and support staff.

In another related study on HCWs knowledge, attitudes and practices on tuberculosis infection control, Nepal, the level of knowledge on TBIPC among HCWs was found to be poor (45.8%) (Shrestha et al., 2017). Researchers have indicated that due to the limited knowledge of TBIPC measures, HCWs have expressed serious concerns about the dangers they are exposed to in the various health facilities regarding TB infection It is therefore important that HCWs have adequate knowledge of TBIPC measures in order to reduce the rate of transmission of TB among them in health care settings. However, knowledge of HCW does not guarantee proper practice of TBIPC measures in the health facilities (Demissie Gizaw et al., 2015).

2.6 Factors influencing TBIPC practices

There are several demographic characteristics of HCWs that can influence TBIPC practices. For instance, Demissie Gizaw et al., (2015) found a significant association between effective practice of TBIPC and years of working among HCWs in Addis Ababa. Shrestha et al., (2017) found out that poor TBIPC practices could be attributed to lack of TBIPC policy and/or guideline both at national and institutional levels. Tenna et al., (2013) also identified in their study, Infection control knowledge, attitudes and practices among healthcare workers in Addis Ababa, Ethiopia, that potential barriers to the effective implementation and practice of TBIPC measures included lack of infrastructure, training, and infection control role models. A study on HCWs knowledge, attitudes and practices on tuberculosis infection control, Nepal, clearly indicated a gap in training on TBIPC for HCWs which attributed to poor knowledge and practice of TBIPC measures (Shrestha et al., 2017). In another cross sectional study on TB infection control knowledge and

attitudes among health workers in Uganda. Buregyeya et al., (2016) also found out that healthcare workers without adequate training had poor TB knowledge and attitude towards TBIPC practices.

2.7 Conclusion of Literature Review

Front-line HCWs are usually the first to experience the ramifications of a progressively more resistant and fatal TB epidemic (von Delft et al., 2015). The rising incidence of the HIV pandemic and DR-TB have made TB control efforts even more challenging and this has led to a greater concern towards TBIPC (Shrestha et al., 2017). HCWs are in short supply in most resource poor settings and should be considered extremely important national assets but it appears they are dispensable, at least in the minds of policymakers, who persistently fail to apportion adequate resources to ensure their safety in healthcare facilities (von Delft et al., 2015). Efficient implementation of TBIPC measures in healthcare facilities bank on prompt identification and isolation of cases as well as the rapid and efficacious treatment of TB patients (Temesgen & Demissie, 2014). HCWs are undeniably pivotal in the implementation of all facets of TBIPC measures, however, they are unable to comply to these protocols all the time (Brouwer et al., 2014).

CHAPTER THREE

METHODOLOGY

3.1 Study Design

This study was quantitative, descriptive and cross-sectional in nature.

3.2 Study Area

The study was conducted at four (4) selected government hospitals in the Accra Metropolis in the Greater Accra region, the capital city of Ghana. The Accra metropolis has four (4) main government hospitals: Princess Marie Louise Children's Hospital in the Ashiedu Keteke sub-metro, Achimota Hospital in the Ayawaso sub-metro, Greater Accra Regional Hospital in the Osu-Clottey sub-metro and La General Hospital in the Kpeshie sub-metro (Figure 3). Additionally, there are numerous small government clinics, quasi government health facilities, private clinics and hospitals in the Accra Metropolis.

Figure 2: Map showing locations of Achimota, La General, Greater Accra Regional and Princess Marie Louise Children's Hospitals all in the Accra Metropolis

3.3 Study Variables

3.3.1 Dependent variable

The dependent variable is TBIPC practices among nurses and doctors.

3.3.2 Independent variables

The independent variables are:

- Socio-demographic factors: age, sex, educational level, professional category, number of years in service
- Knowledge of TBIPC
- TBIPC training
- Factors affecting implementation and practice of TBIPC measures

3.4 Study Population

The population for this study were nurses and doctors providing care in the clinical setting at the selected government hospitals in the Accra Metropolis. This is because although health workers are generally at risk of contracting occupational TB, the risk is greater in nurses and doctors (Oxley et al., 2018)

3.4.1 Inclusion Criteria

The eligible participants were nurses and doctors working at the selected government hospitals in the Accra metropolis: La General Hospital, Achimota Hospital, Princess Marie Louise Children's Hospital and Greater Accra regional Hospital who agreed and consented to be part of the study.

3.4.2 Exclusion criteria

Nurses and doctors who were doing their internship (Rotation Nurses and House Officers) were excluded from the study. Nurses and doctors who had worked for less than six (6) months were excluded because of their short work experience and were also likely not to have undergone any form of TBIPC training.

3.5 Sampling

3.5.1 Sample Size

A sample size was derived using the Cochran's formula. The sample size was determined based on a proportion (51.4%) of HCWs who had good practice on TBIPC in a previous study done in Ethiopia (Demissie Gizaw et al., 2015).

The formula is as stated below:

$$n = \frac{Z^2_{1-\frac{\alpha}{2}} P(1-P)}{e^2} * (1+r)$$

n = The sample size

z = 95% confidence interval (standard value 1.96).

e = The desired level of precision or level of acceptable error = 0.05

r = Non response rate of 10% to deal with uncompleted and unreturned questionnaires

$$n = \frac{1.96^2[0.514(1-0.514)]}{0.05^2} * (1+0.1)$$

p = Prevalence of 51.4% based on a proportion of HCWs who had good practice on TBIPC in a previous study done in Ethiopia (Demissie Gizaw et al., 2015).

Therefore, the sample size for this study was 423 with the assumptions of 95% confidence level and 5% precision.

3.5.2 Sampling Technique

Proportionate stratified sampling technique was used in selecting participants for this study. The proportion of nurses and doctors sampled from each hospital were based on total population of nurses and doctors in the facility. The four hospitals have a total of about 1453 nurses and doctors. Study participants were comprised as follows; 20% from Achimota Hospital, 19% from La General Hospital, 12% from Princess Marie Louise Children's Hospital and 49% from Greater Accra Regional Hospital. In each facility, nurses and doctors who were on duty during the data collection period were approached and consent sought to be included in the study.

3.5.3 Sample size distribution

The four institutions were treated as different strata and sampled based on the total population of nurses and doctors in each institution as provided by their directors of human resources.

Table 1: Sample size distribution

Hospital (strata)	Nurses	Doctors	Total Population	Number sampled	Percentage sampled
Achimota Hospital	261	25	286	83	20%
Greater Accra Regional Hospital	642	75	717	209	49%
La General Hospital	250	30	280	81	19%
Princess Marie Louis Children's Hospital	150	20	170	50	12%
Total	**1303**	**150**	**1453**	**423**	**100%**

3.6 Questionnaire

A structured questionnaire (Appendix C) with both precoded and open ended formats that showed socio-demographic variables such as sex, age, education, professional category and number of years worked as well as a section for assessment of knowledge and administrative resource availability about TBIPC measures were asked. The questionnaire was self-administered due to the high literacy rate of respondents.

3.7 Quality control

A well-structured and pretested questionnaire was administered to respondents and their responses aided collection of the data set. The data collection tool was adopted and modified from a previous

study (Lipke et al., 2016). The tool was based on the WHO recommendations in the policy on TBIPC in healthcare facilities, congregate settings and households and the CDC's guidelines for preventing the transmission of *Mycobacterium tuberculosis* in healthcare settings.

The reliability of the questionnaire was tested and Cronchbac's alpha of 0.8 was obtained which indicated an excellent reliability coefficient. Four research assistants with Public health (PH) background were recruited. They were trained and supervised to effectively administer the questionnaires. They were monitored adequately during the data collection process up to the end of the study. Data was collected from every respondent and series of checks conducted after daily field work to ensure that questionnaires were well completed and appropriately filled with accurate information before final analysis.

3.8 Data analysis

Data from the questionnaire (Appendix C) was coded and entered into Microsoft Excel data sheet. Data analysis was done by vetting the questionnaire and entering into STATA software package version 15 for editing and analysis.

3.8.1 Knowledge level of nurses and doctors on TBIPC measures

To assess knowledge level, 11 questions were asked on TBIPC measures. A score of "0" was assigned to an incorrect answer and "1" for a correct answer. Depending on the summative score of the questions designed to assess knowledge, respondents with a mean score above 60%, (that is, a score of ≥ 7 out of 11) and above were classified as having adequate knowledge while those with mean score below 60% (that is, a score of ≤ 7 out of 11) were classified as having inadequate knowledge (Ministry of Health. Ethiopia 2011).

3.8.2 Proportion of nurses and doctors with effective TBIPC practices

To determine proportion of HCWs who utilize effective TBIPC practices, 8 questions were asked with regards to practice of TBIPC measures. Respondents were asked to choose from the following answers; "always", "sometimes", "rarely", and "never". Respondents who chose "always" were given a score of 1 and those that chose "Sometimes", "Rarely", and "Never" were given a score of 0. A score of zero was allocated to the responses "sometimes", "rarely", and "never" because TBIPC practices are expected to be strictly adhered to always since not doing so increases the risk of nosocomial transmission of TB. The interest was in whether health care providers practiced TBIPC always (score of 1) or not (score of zero). A summative score above 60%, that is, a score of ≥ 5 out of 8 were classified as having effective TBIPC practices while those with scores below 60% (that is, ≤ 5 points out of 8) were classified as having ineffective TBIPC practices (Ministry of Health, Ethiopia 2011).

3.8.3 Administrative Measures

Administrative controls were assessed by asking Eight (8) questions related to the availability and use of resources in the health facilities. This was done by using a Likert scale with 5 point ratings: "strongly agree", "agree", "neutral", "disagree" and "strongly disagree". Each question was labeled with either positive or negative responses with respondents choosing only one response. Strongly agree was given the highest score of 1, agree (2), neutral (3), disagree (4) and strongly disagree (5) when a positive response is needed. When a negative response is however needed, strongly disagree was given the highest score of 1, disagree (2) in that order. Thus the least score would be 8, median score, 24 with and highest score, 40. Any respondent with an administrative score below the median was classified as working in an institution with proper administrative controls while those with average scores above the median were classified as working in an

institution with improper administrative controls. An average score equal to the median were however classified as intermediate administrative controls although not acceptable since proper administrative controls in healthcare institutions are required at all times to safeguard the health of HCWs (Ministry of Health, Ethiopia, 2011).

3.8.4 Factors influencing TBIPC practices among nurses and doctors

Descriptive analysis using mean, standard deviation, frequencies and percentages were used to describe the different independent variables. Bivariate analysis using chi-square was conducted to determine if there were any significant association between the dependent and independent variables. Using the predictor variables that were found (from the X^2 test) to be significantly associated with practice of TBIPC, a multiple logistic regression analysis was then conducted to determine their association with the TBIPC practices. Crude odds ratio (COR) and Adjusted odds ratio (AOR) were determined for each of the independent variables and statistical significance was accepted at ($p \leq 0.05$).

3.9 Ethical considerations/issues

Approval for the study was sought from the Ethical Review Committee of the Ghana Health Service. Permission was also sought from the Regional Health Directorate, and Heads of the four health facilities used for the study.

3.9.1 Informed Consent

Informed consent was obtained from the respondents before they participated in the study. Their participation in this study was absolutely voluntary. Additionally, they were at liberty to withdraw from the study at any given time.

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3.9.2 Confidentiality

All information collected from participants were kept confidential and would not be traceable to participants. Participants were assured that information collected would solely be used for research purposes and they would not be named in any report dissemination or publication arising from this scholarly work.

3.9.3 Compensation

No compensation was given to respondents who participated in this study. This was made known to them before commencement of data collection.

3.9.4 Risk and Benefits

Apart from the time that was lost by participants in answering the questionnaires, there were no risks or cost associated in choosing to participate in the study. However, findings from this study are expected to inform management decisions and policies aimed at improving TBIPC measures in healthcare facilities in Ghana to help prevent nosocomial transmission of TB and eventually help reduce the national and global burden of TB.

3.9.5 Pretest or pilot study

Pretesting of questionnaire was done at the Korle-bu Teaching Hospital, Accra among 45 nurses and doctors who had worked for more than six (6) months. This helped in identifying questions which were incomprehensible to respondents as well questions that might lead to biased answers. The pretest gave an insight into the duration required to administer the questionnaire. After the pre-test, the questionnaire was revised accordingly and finalized for the actual field work.

3.9.6 Data storage and usage

Data collected in this study was strictly for research purposes. The data was stored with passwords on electronic media and in safely locked boxes. Anonymity was ensured in dissemination of findings from this study since participants were not be identified by their names.

3.9.7 Declaration of conflict of interest

The researcher as the principal investigator does hereby declare no conflict of interest in this study.

3.9.8 Funding of the study

The study was self-sponsored.

CHAPTER FOUR

RESULTS

4.1 Socio-demographic characteristics of respondents

A total of 423 participants were recruited in the study. However, only 403 consisting of 26.8% (108/403) doctors and 73.2% (295/403) nurses responded to the questionnaire giving a response rate of 95.3%. Most respondents (45.2 %) were between the ages of 26-31 years with mean age 31.1 ± 0.25 SD years. About 63.3% were females and 36.7% were males. Majority, (49.9%) had a first degree and above as their qualification. About 47.4% had worked for a period between 2-5 years (Table 2).

Table 2: Socio-demographic characteristics of respondents

Variable	Frequency	Percentage (%)
Age of respondents (Yrs.)		
20-25	53	13.2
26-31	182	45.2
32-37	133	33.0
38-43	30	7.4
44-49	2	0.5
≥50	3	0.7
Sex (N=403)		
Male	148	36.7
Female	255	63.3
Educational level of respondents (N= 403)		
Certificate	40	9.9
Diploma	162	40.2
Degree and Above	201	49.9
Professional category (N=403)		
Doctors	108	26.8
Nurses	295	73.2
Number of years worked (N=403)		
<1	98	24.3
2-5	191	47.4
6-9	69	17.1
10-13	35	8.7
≥14	10	2.5

4.2 Knowledge on TBIPC Practices

The results showed that 241 (59.8%) had adequate knowledge while 162 (40.2%) had inadequate knowledge on TBIPC practices (Table 7). Ninety-three percent were able to give the correct description of how TB is spread.

Respondents knowledge on requirements of TB examination or treatment room was assessed and 224 (55.6%) gave a correct response that examination of a suspected TB patient should not be in a room with ventilation solely by air condition. With regards to knowledge on an easy and low-cost way to reduce the number of infectious TB droplets in the air, most respondents 220 (54.6%) gave a correct response that one must use natural ventilation by opening windows and doors and maximizing cross -ventilation.

Participants' score on their knowledge of cough etiquettes showed that majority, 326 (80.9%) answered correctly that cough etiquettes includes covering your coughs and sneezes with handkerchief, tissue, or upper arm. Concerning the most effective intervention for TB control, 245 (60.8%) answered correctly that there should be the need for early detection of TB patients and when detected, there should be appropriate treatment given. Participants' knowledge of who uses surgical masks in an environment where TB transmission was a risk was sought and 370 (91.8%) gave a correct response that surgical masks should be used by coughing patients. Participants were asked to indicate whether managerial control measures for TB infection control included instituting screening of health care workers on TB and 339 (84.3%) answered in the affirmative (Table 3).

Table 3: Knowledge on TBIPC measures

Variable	Frequency	Percentage (%)
Description of how TB is spread (N=403)		
Correct response	376	93.3
Incorrect response	27	6.7
Hospital staff should implement effective administrative control measures		
Correct response	291	72.2
Wrong response	112	27.8
Examinations of treatment room for TB patients		
Correct response	224	55.6
Incorrect response	179	44.4
How to reduce the number of infectious TB droplets in the air		
Correct response	220	54.6
Incorrect response	183	45.4
Cough etiquette		
Correct response	326	80.9
Wrong response	77	19.1
Use of particulate respirators		
Correct response	128	31.8
Wrong response	275	68.2
Most effective intervention for TB control		
Correct response	245	60.8
Wrong response	158	39.2
Use of surgical mask where TB transmission is a risk		
Correct response	370	91.8
Wrong response	33	8.2
Small areas with minimal ventilation should be used for sputum collection		
Correct response	242	60.1
Wrong response	161	39.9
Managerial control measures for TB infection control include instituting screening of health care workers on TB		
Correct response	339	84.3
Wrong response	63	15.7

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4.3 TBIPC training

Table 4 summarizes the results of TBIPC training among the respondents. The results revealed that only 28.8% of respondents had ever attended TBIPC training within the past three years. Out of the respondents who had ever attended a training on TBIPC, about 57.8% had attended training twice and about 56.9% perceived the training as extremely useful.

Table 4: Tuberculosis infection prevention and control training

Variable	Frequency	Percentage (%)
Ever attended TBIPC training (N=403)		
Yes	116	28.8
No	287	71.2
If yes indicate how many times (N=116)		
Once	43	37.0
Twice	67	57.8
Thrice	6	5.2
Usefulness of training (N=116)		
Extremely useful	66	56.9
Very Useful	32	27.6
Moderately Useful	18	15.5

4.4 TBIPC Practices

Table 5 describes TBIPC measures practiced by respondents. About 54.8% of respondents sometimes adopted the use of posters to educate and increase patient's awareness on TB and 21.8% always used it. It was also found out that 46.7% of respondents sometimes educated coughing patients to apply cough etiquette while forty percent educated coughing patients always. The results also showed that 46.2% of respondents sometimes separated or fast tracked patients who were identified as TB suspects from other patients in waiting areas and 33.5% always did it as a control measure. About 54.1% asserted that they sometimes separated or grouped suspected or confirmed TB patients from other patients on the ward while 29.3% always did it. With regards to

the use of Personal Protective Equipment (PPE), 37.5% asserted that they sometimes wore N95/FFP2 mask when working in high risk TB areas, 36.9% always wore masks and 20.8% rarely wore it.

Concerning the offering of surgical mask to TB suspects or cases when they are in the hospital, 11.9% reported they always did it, 40% sometimes did it, 24.6% rarely did it and 23.5% never did it. With respect to hand hygiene, majority (92.3%) asserted they always practiced hand hygiene anytime they came into contact with patients' respiratory secretions or carry out other procedures (Table 5).

Table 5: TBIPC Practices

Variable	Frequency	Percentage (%)
Use of posters to educate and increase patients awareness on TB		
Always	88	21.8
Sometimes	221	54.8
Rarely	70	17.4
Never	24	6.0
Educate coughing patients to apply cough etiquette		
Always	157	40.0
Sometimes	188	46.7
Rarely	46	11.4
Never	12	2.9
I separate or fast track patients who are identified as TB suspects from other patients in waiting areas		
Always	135	33.5
Sometimes	186	46.2
Rarely	66	16.4
Never	16	3.9
In the wards, I separate or group suspected or confirmed TB patients from other patients		
Always	118	29.3

the use of Personal Protective Equipment (PPE). 37.5% asserted that they sometimes wore N95/FFP2 mask when working in high risk TB areas. 36.9% always wore masks and 20.8% rarely wore it.

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Educate coughing patients to apply cough etiquette		
Always	157	40.0
Sometimes	188	46.7
Rarely	46	11.4
Never	12	2.9
I separate or fast track patients who are identified as TB suspects from other patients in waiting areas		
Always	135	33.5
Sometimes	186	46.2
Rarely	66	16.4
Never	16	3.9
In the wards, I separate or group suspected or confirmed TB patients from other patients		
Always	118	29.3

Sometimes	218	54.1
Rarely	58	14.4
Never	9	2.2
I educate suspected TB patients to wash their hands anytime they produce respiratory secretions		
Always	128	31.8
Sometimes	181	44.9
Rarely	79	19.6
Never	15	3.7
I wear N95/FFP2 mask when working in high risk TB areas.		
Always	149	36.9
Sometimes	151	37.5
Rarely	84	20.8
Never	19	4.8
I offer surgical mask to TB suspects or cases when they are in the hospital		
Always	48	11.9
Sometimes	161	40.0
Rarely	99	24.6
Never	95	23.5
I practice hand hygiene anytime I come into contact with patients with respiratory secretions or carry out other procedures.		
Always	372	92.3
Sometimes	24	6.0
Rarely	4	0.9
Never	3	0.8

4.5 Administrative Controls for Effective Implementation of TBIPC Measures

Table 6 sums up the results of administrative controls at the various hospitals as reported by respondents. About 47.5% of respondents disagreed when they were asked whether they had access to resources to prevent TB infection such as hand hygiene items, surgical mask and N95 in their workplaces. Nearly half, 49.4% of respondents disagreed with the assertion that patient's visual alerts, example posters advising patient to inform staff if they have respiratory symptoms,

were available at all vantage points in their facility. Sixty five percent of the respondents agreed that the windows and doors in their facility were opened daily for maximum cross ventilation. 46.2% were undecided when they were asked whether sputum microscopy was done in a designated area rather than in the main laboratory in their facility.

When respondents were asked whether patients with active TB were most often admitted to the same ward with other patients, 44.2% strongly disagreed to this assertion.

Approximately 38.7% of respondents agreed to the fact that propelling fans example (ceiling fans) and air conditioners were most often used in their facility than natural cross ventilation while 32% disagreed. However, 44.2% of respondents disagreed that ceiling fans in their facility were functioning, cleaned and in good condition all the time (Table 6)

Table 6: Administrative Controls for Effective Implementation of TBIPC Measures

Variable	Frequency	Percentage (%)
In my workplace I have access to resources to prevent TB infection such as hand hygiene items, surgical mask andN95		
Strongly Agree	31	7.7
Agree	151	37.6
Neutral	27	6.7
Disagree	191	47.5
Strongly disagree	2	0.5
Patient's visual alerts example Posters advising patient to inform staff if they have respiratory symptoms are available at all vantage points in my facility.		
Strongly Agree	32	7.9
Agree	113	28.0
Neutral	33	8.2
Disagree	199	49.4
Strongly disagree	26	6.5
My facility has set up quick turnaround times for TB cases.		
Strongly Agree	18	4.5
Agree	248	61.5
Neutral	59	14.6
Disagree	75	18.6
Strongly disagree	3	0.7
The windows and doors in my facility are opened daily for maximum cross ventilation.		
Strongly Agree	41	10.2
Agree	262	65.0
Neutral	47	11.7
Disagree	51	12.7
Strongly disagree	2	0.6
Sputum microscopy is done in a designated area rather than in the main laboratory.		
Agree	70	17.4
Neutral	186	46.2
Disagree	48	11.9

Strongly disagree	70	17.4
Agree	29	7.1
Patients with active TB are most often admitted to the same ward with other patients		
Strongly Agree	12	2.9
Agree	36	8.9
Neutral	18	4.5
Disagree	159	39.5
Strongly disagree	178	44.2
Propelling fans example (ceiling fans) and air conditioners are most often used in my facility than natural cross ventilation.		
Strongly Agree	17	4.2
Agree	156	38.7
Neutral	41	10.2
Disagree	129	32.0
Strongly disagree	60	14.9
Ceiling fans are functioning, cleaned and in good condition all the time.		
Strongly Agree	21	5.2
Agree	109	27.1
Neutral	62	15.4
Disagree	178	44.2
Strongly disagree	33	8.1

Table 7: Practice, Knowledge and Administrative Scores of Respondents

Variable	Frequency	Percentage (%)
Practice (N=403)		
Effective	109	27.1
Ineffective	294	72.9
Knowledge (N=403)		
Adequate	241	59.8
Inadequate	162	40.2
Administrative Controls (N = 403)		
Improper controls	178	44.2
Intermediate	59	14.6
Proper control	166	41.2
TBIPC implementation challenges (N=403)		
Lack of resources	190	47.2
Lack of PPEs	170	42.2
Inadequate training	43	10.6

4.6 Bivariate associations among TBIPC practices, socio-demographic characteristics and other factors

A bivariate analysis was performed to examine the relationship between socio-demographic and other variables and TBIPC practices at 5% level of significance. The results showed that there were statistically significant associations between age ($p < 0.001$), sex ($p < 0.001$), educational level ($p\ 0 < 0.001$), profession ($p = 0.001$), number of years worked ($p = 0.007$) and TBIPC practices (Table 8). Other variables that were also significantly associated with TBIPC were knowledge on TB ($p = 0.013$), ever attended TBIPC training ($p < 0.001$) and frequency of training on TBIPC ($p = 0.007$). Administrative control measures were also found to be significantly associated with TBIPC practices ($p = 0.001$) (Table 9).

Table 8: Association between Demographic Characteristics and TBIPC (n=frequency)

	TBIPC practice n (%)			Chi-square
	Effective	Ineffective	Total	p- value
Age				<0.001*
20-25	8 (15.1)	45(84.9)	53 (100.0)	
26-31	33 (18.1)	149 (81.9)	182 (100.0)	
32-37	65 (48.8)	68 (51.2)	133 (100.0)	
38-43	2 (6.7)	28 (93.3)	30 (100.0)	
44-49	1 (50.0)	1(50.0)	2 (100.0)	
>50	0 (0.0)	3(100.0)	3 (100.0)	
Sex				<0.001*
Male	68(45.9)	80(54.1)	148 (100.0)	
Female	41(16.1)	80(83.9)	255 (100.0)	
Educational level				<0.001*
Certificate	6 (15.0)	34 (85.0)	40 (100.0)	
Diploma	24(14.8)	138(85.2)	162 (100.0)	
Degree and Above	79 (39.3)	122 (60.7)	201(100.0)	
Profession				0.001*
Doctor	42 (38.9)	66 (61.1)	108 (100.0)	
Nurse	67(22.7)	228 (77.3)	295 (100.0)	
Experience (Years)				0.007*
<1	19(19.4)	79 (80.6)	98 (100.0)	
2-5	68 (35.6)	123 (64.4)	191 (100.0)	
6-9	15 (21.7)	54 (78.3)	69 (100.0)	
10-13	6 (17.1)	29 (82.9)	35(100.0)	
≥14	1(10.0)	9 (90.0)	10 (100.0)	

*Significant at p≤0.05

Table 9: Association between Other Factors and TBIPC (n=frequency)

	TBIPC practice n (%)			Chi-square p- value
	Effective	Ineffective	Total	
Knowledge of TB				0.013*
Inadequate	33 (20.4)	129 (79.6)	162 (100.0)	
Adequate	76 (31.5)	165 (68.5)	241 (100.0)	
Ever attended TB training				<0.001*
Yes	87 (75.0)	29 (25.0)	116 (100.0)	
No	22 (7.7)	265 (92.3)	287 (100.0)	
Frequency of training				0.007*
Once	26 (60.0)	17(40.0)	43 (100.0)	
Twice	58 (86.6)	9 (13.4)	67 (100.0)	
Thrice	4 (66.7)	2(33.3)	6 (100.0)	
Administrative controls				0.001*
Improper	57 (32.0)	121(68.0)	178 (100.0)	
Intermediate	4 (6.8)	55 (93.2)	59 (100.0)	
Proper	48 (28.9)	118 (71.1)	166 (100.0)	

*Significant at p≤0.05

4.7 Multiple logistic regression showing strength of association

Multiple logistic regression analysis was conducted on all factors that were statistically significant at the bivariate level. These factors were educational level, number of years worked, knowledge on TB and ever had training on TBIPC (see Table 10). The results showed that nurses and doctors with educational level of degree and above were 2.87 times more likely to have effective TBIPC practices compared to those with certificates (AOR=2.87; 95% CI=1.182-7.832). Nurses and doctors who had worked for a period between 2-5 years were 1.93 times more likely to have effective TB practices compared to those who had worked for less than one year (AOR= 1.93; 95% CI=1.03-10.107).

Nurses and doctors with adequate knowledge on TB were 2.23 times more likely to practice effective TBIPC measures compared to those with inadequate knowledge (AOR= 2.23 ; 95% CI=1.671-7.428)

Nurses and doctors who had never had any training TBIPC had 82% reduced odds of practicing effective TBIPC measures compared to those who had training (AOR= 0.18 ; 95% CI = 0.011-0.630) (Table 10)

Nurses and doctors with adequate knowledge on TB were 2.23 times more likely to practice effective TBIPC measures compared to those with inadequate knowledge (AOR= 2.23 ; 95% CI=1.671-7.428).

Nurses and doctors who had never had any training TBIPC had 82% reduced odds of practicing effective TBIPC measures compared to those who had training (AOR= 0.18 ; 95% CI = 0.011-0.630) (Table 10)

Table 10: Multiple Logistics regression of the factors associated with TBIPC practices

Variable	Effective n (%)	Ineffective n (%)	COR (95%CI)	AOR(95%CI)
Age				
20-25	8 (15.1)	45(84.9)	1.0	1.0
26-31	33 (18.1)	149 (81.9)	1.25 (0.537-2.889)	0.42 (0.061-2.914)
32-37	65 (48.8)	68 (51.2)	**5.38 (2.756-12.27)**	3.27 (0.782-10.284)
38-43	2 (6.7)	28 (93.3)	0.40 (0.079-2.029)	0.82 (0.340-2.42)
44-49	1 (50.0)	1(50.0)	5.63 (0.318-9.408)	2.76 (0.182-8.432)
≥50	0 (0.0)	3(100.0)	0.0	0.0
Sex				
Male	68 (45.9)	80 (54.1)	1.0	1.0
Female	41 (16.1)	80 (83.9)	**0.23 (0.142-0.359)**	0.49 (0.136-1.753)
Educational level				
Certificate	6 (15.0)	34 (85.0)	1.0	1.0
Diploma	24(14.8)	138(85.2)	0.98 (0.374-2.600)	0.97 (0.251-3.786)
Degree and Above	79 (39.3)	122 (60.7)	**3.67 (1.473-9.142)**	**2.87(1.182-7.832)**
Profession				
Doctor	42 (38.9)	66 (61.1)	1.0	**1.0**
Nurse	67(22.7)	228 (77.3)	**0.462 (0.288-0.741)**	1.43 (0.307-6.653)
Experience				
≤1	19 (19.4)	79 (80.6)	**1.0**	**1.0**
2-5	68 (35.6)	123 (64.4)	**2.29 (1.284-4.113)**	**1.93 (1.03-10.107)**
6-9	15 (21.7)	54 (78.3)	1.15 (0.539-2.470)	1.32 (0.171-10.274)
10-13	6 (17.1)	29 (82.9)	0.86 (0.313-2.366)	0.45 (0.219-5.432)
≥14	1(10.0)	9 (90.0)	0.46 (0.551-3.871)	0.38 (0.173-6.371)
Knowledge				
Inadequate	33 (20.4)	129 (79.6)	1.0	
Adequate	76 (31.5)	165 (68.5)	**1.80 (1.126 - 2.878)**	**2.23(1.671-7.428)**
Ever attended TB training				
Yes	87 (75.0)	29 (25.0)	1.0	1.0
No	22 (7.7)	265 (92.3)	**0.03 (0.015-0.512)**	**0.18 (0.011-0.630)**
Frequency of training				
Once	26 (60.0)	17(40.0)	1.0	
Twice	58 (86.6)	9 (13.4)	**4.21(1.661 - 10.690)**	2.82 (0.022-8.876)
Thrice	4 (66.7)	2(33.3)	1.30 (0.215 - 7.944)	1.27(0.325-6.542)

n (%) represents frequency (percentage), COR represents Crude Odds Ration, AOR represents Adjusted Odds Ratio and CI represents confidence interval

CHAPTER FIVE

DISCUSSION

5.1 Knowledge on TBIPC practices

In order to reduce the rate of transmission of TB among nurses and doctors, it is important they have adequate knowledge on TBIPC measures. This is because a thorough knowledge of how TB is transmitted is very critical for the implementation and practice of TBIPC measures (Steinberg, 2014). Overall, the proportion of nurses and doctors with adequate knowledge on TBIPC measures in this study was 59.8% and thus had 2.23 increased odds of having effective TBIPC practices compared to those with inadequate knowledge.

The knowledge score of 59% in this study, was higher compared to a study in Nepal where 54% of HCWs scored "good" level of knowledge on TBIPC measures (Shrestha et al., 2017). The dissimilarity in the scores may be due to the differences in the study population where all HCWs (including non-clinical staff such as administrators) were sampled in the Nepal study while this study only considered doctors and nurses. These nurses and doctors may have had TBIPC as part of their syllabi content during their professional education and are also likely to have undergone some form of training on TBIPC.

In contrast, the knowledge score of 59% was lower compared to a similar study in South Africa where the mean knowledge score of HCWs was 61.5% (Steinberg, 2014). The variation in the scores can be attributed to the smaller sample size of 129 in the South African study compared to the 403 in this current study. Regardless, the knowledge score of 59% revealed in this study is moderate at best and should be improved upon since knowledge deficit is a major barrier to implementation and practice of TBIPC in healthcare facilities (Shrestha et al., 2017).

5.2 Proportion of Doctors and Nurses with effective TBIPC practices.

The proportion of nurses and doctors with effective TBIPC practices was as low as 27.1%. This proportion were those who practiced TBIPC measures always. This suggests HCWs in the studied healthcare facilities are at risk of nosocomial transmission of TB due to ineffective practice of TBIPC measures. This may be due to lack of training on TBIPC since only 28.8% of participants had ever had any form of training on TBIPC which is woefully inadequate. This can also be attributable to lack of resources such as posters for patient education; overcrowding and lack of adequate space for isolation of TB patients at health facilities; irregular supply of PPEs such as nose mask and N95 mask as reported by respondents. Approximately 47.2% and 42.2% of participants cited lack of resources and lack of PPEs respectively as challenges that they face in the implementation and practice of TBIPC strategies and measures in their facilities. This assertion is supported by a similar study by Storla et al., (2008), which also mentioned lack logistics, irregular supply of PPEs such as nose mask and N95 mask, and lack of training as major challenges that impeded the implementation and practice of TBIPC measures. Congruently, Temesgen and Demissie (2014) also reported that inadequate logistics and lack of training led to poor implementation and practice of TBIPC measures in a similar study.

The findings from this study are consistent with a similar study in Maluti Adventist Hospital where HCWs scored low TBIPC practices of 36.4 % and cited poor administrative controls, lack of respirators as some contributing factors (Steinberg, 2014). However, the low TBIPC practices of 27.1% revealed in this study are inconsistent with the findings in another study done in South Africa where 72.9% of respondents reported good practices (Engelbrecht et al.,2016). Engelbrecht et al., (2016), however asserts that observations of practices at the facilities revealed this high

proportion of 72.9% to not necessarily be the case. He purported that respondents may have reported high scores to look good in the eyes of the researchers.

5.3 Factors influencing TBIPC practices

Educational level, professional category, number of years worked were the determinants of effective TBIPC practices. The study revealed that nurses and doctors with educational level of degree and above were more likely to practice effective TBIPC compared to those with diploma and certificates. This could be attributed to the fact that at the degree or masters level, most HCWs are more likely to have much knowledge because of syllabi content and this might in turn influence their practice.

It was observed that nurses and doctors who had worked for a period between 2-5 years were more likely to have effective TBIPC practices compared to those who had worked for less than one year. This is in agreement with a study in Addis Ababa, Ethiopia where HCWs with more than six years working experience were 2.51 times more likely to have effective TBIPC practices compared to those who had worked for less than 3 years (Demissie Gizaw et al., 2015). These findings might stem from the fact the more the number of years worked, the greater the experience acquired and thus the more likely it is for HCWs to learn some TBIPC measures on the job compared to those with little experience.

This current study did not consider age, sex, profession as predictors or determinants of TBIPC practices and it is consistent with the work of Temesgen & Demissie (2014) who also found no significant difference between practice and demographic charactersitics such as sex. Contrastingly, a similar study done in India revealed socio-demographic characteristics as a predictor of effective TBIPC practices (Sreeramareddy et al., 2014).

Training was also found to be positively associated with effective practice of TBIPC measures in this study. Nurses and doctors who had never attended training on TBIPC had an 82% reduced odds of practicing effective TBIPC measures compared to those who had training. Similarly, training was found to be a predictor of TBIPC practice in a study among health professionals in Ethiopia which revealed that those who had TB related training had an increased odd of 2.51 of having effective practice compared to those without any training (Demissie Gizaw et al., 2015). In contrast, a study in South Africa among HCWs did not find TB related training to be a predictor of good practices (Engelbrecht et al., 2016). In congruence, another study in Northwest Ethiopia found training on TBIPC to be a predictor of good knowledge but not of good practice (Temesgen & Demissie, 2014). This they reported could be attributed to the fact that training was more theoretical than skill based and questioned the quality of those trainings.

CHAPTER SIX

CONCLUSION AND RECOMMENATIONS

6.0 Conclusion

This study sought to examine the knowledge and practice of TBIPC measures among nurses and doctors at four (4) selected government hospitals in the Accra Metropolis. The proportion of nurses and doctors with effective TBIPC practices were low (27.1%). However, the overall knowledge score of nurses and doctors on TBIPC was moderate (59.8%). Level of education, number of years worked, knowledge about TBIPC measures and training on TBIPC were the factors associated with TBIPC practices. It can be inferred from this outcome that knowledge does not always translate into practice.

6.1 Recommendations

- The knowledge score of nurses and doctors on TBIPC measures was moderate (59.8%) and thus needs to be improved upon. Training or refresher courses on TBIPC measures should therefore be organized by the management of the various healthcare facilities for health care professionals to equip them with the needed knowledge to enhance the practice of TBIPC measures.
- Overall, an alarmingly low proportion of nurses and doctors (27.1%), effectively practiced TBIPC measures in their healthcare facilities. This could be attributable to lack of resources such as posters for patient education; overcrowding and lack of adequate space for isolation of TB patients at health facilities; irregular supply of PPEs such as nose mask and N95 mask as reported by respondents. The onus therefore falls on the Ministry of Health to provide the needed logistics and resources including PPEs to health care facilities to help

improve TBIPC practices in healthcare facilities in Ghana. The ministry should also invest in the expansion and or provision of isolation wards in the various health facilities for isolation of suspected TB cases before diagnosis.

- The National TB Control Program should ensure the adoption and implementation of effective TBIPC program by all healthcare facilities as well as carry out periodic monitoring and evaluation of the effectiveness of the TBIPC programs in minimizing the risk of nosocomial transmission of TB in healthcare facilities.
- There should be frequent screening of health care workers for TB to promptly detect and treat infected individuals. Healthcare workers should also seek and attend training programs on TBIPC to improve upon their infection prevention and control practices.
- Research should be carried out to determine the prevalence of both latent and active TB among healthcare workers in Ghana.

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APPENDICES

Appendix A: Participants Information Sheet

STUDY TITLE: KNOWLEDGE AND PRACTICE OF TUBERCULOSIS INFECTION PREVENTION AND CONTROL MEASURES AMONG NURSES AND DOCTORS AT SELECTED GOVERNMENT HOSPITALS IN ACCRA, GHANA.

INTRODUCTION: I am Esther Amene Osei-Yeboah, an MPH student at the School of Public Health University of Ghana Legon. I am conducting a research on the topic Knowledge and Practice of Tuberculosis Infection Prevention and Control Measures among Nurses and Doctors at Selected Government Hospitals in Accra, Ghana in partial fulfillment of the award of a Master's Degree.

BACKGROUND AND PURPOSE OF RESEARCH: Tuberculosis (TB) is currently the leading cause of death worldwide from a single infectious organism. There is increased risk of occupational transmission of TB to health care workers (HCWs) but the risk is greater in nurses and doctors. This is as a result of improper implementation of the tuberculosis infection prevention and control (TBIPC) measures recommended by the World Health Organization (WHO) and lack of knowledge about these measures stemming from no or inadequate training of health workers. The aim of this study is to examine the knowledge and practice of TBIPC measures among nurses and doctors at selected government hospitals in the Accra Metropolis. This will shed light on improper implementation and practices of TBIPC measures in health care facilities that predispose nurses and doctors to nosocomial transmission of tuberculosis.

NATURE OF RESEARCH This is a cross sectional and quantitative study involving a total of 423 Nurses and Doctors working at Greater Accra Regional Hospital, Achimota Hospital, La General Hospital, and Princess Marie Louise Hospital.

PARTICIPANTS INVOLVEMENT: If you agree to participate in this study, you may be required to answer some questions on tuberculosis, practices or measures that you employ to prevent tuberculosis transmission to yourself, colleagues and patients, training you have received on TBIPC as well factors that affect the practice and implementation of TBIPC measures at your facility The questions will require approximately 30- 40 minutes for completion.

POTENTIAL RISK. There is minimal risk involved in this study as you may be uncomfortable with answering some of the questions. If such a situation happens, you can skip those questions or withdraw from the study without penalty and without having to give any reasons.

BENEFITS AND COMPENSATION: There is no compensation or direct benefit from your participation in this study. However, the information obtained from this study will inform management decisions aimed at improving TB control practices in Health Care Centers in Ghana to help decrease the nosocomial transmission of TB and eventually help reduce the national and global burden of tuberculosis.

COSTS: Participation in this study will be at no cost to you since questionnaires will administered on days that they are on duty.

CONFIDENTIALITY: All the information collected from the study participants will be kept confidential and will not be traceable to the participants. Data will be under lock and key and electronic versions will be password protected with only the PI having access to them. You will not be identified by name in any dissemination reports or publications resulting from this study.

VOLUNTARY PARTICIPATION OR WITHDRAWAL: Participation in this study is voluntary and decision to participate, stay or withdraw from study is at the discretion of the participant and will be of no consequence.

OUTCOME AND FEEDBACK: Findings from this research will be published in a peer reviewed journal. A report will also be sent to the Ethics Review Committee.

FUNDING: This study is self-sponsored.

SHARING OF PARTICIPANTS INFORMATION/DATA: The data will be used only by the Principal Investigator (PI), solely for research and academic purposes. Data will not be shared with any individual or organisation and will be destroyed by burning questionnaires after five (5) years. Ethical clearance will be sought again should the need arise for reuse of the data by the PI.

PROVISION OF INFORMATION AND CONSENT FORM: You will be given a copy of the information sheet and Consent form after it has been signed to keep.

Any questions or additional information should be directed to the Principal Investigator (PI) Esther Amene Osei-Yeboah, Department of Biological, Environmental and Occupational Health, School of Public Health, University of Ghana,

Phone contact: 0246693167, Email: meaka2015@gmail.com

Or

Dr. Paul Kingsely Botwe, Department of Biological, Environmental and Occupational Health, School of Public Health, University of Ghana,

Phone contact: 0205944689, Email: pual.botwe@utas.edu.au

Or

Miss Hannah Frimpong, of the Ethics Review Committee (ERC) of the Ghana Health Service (GHS),

Phone Contact. 0507041223, Email: hannah.frimpong@ghsmail.org or ghserc@gmail.com

Appendix B: Consent Form

PARTICIPANTS' STATEMENT

I acknowledge that I have read or have had the purpose and contents of the Participants' Information Sheet read and satisfactorily explained to me in English. I fully understand the contents and any potential implications as well as my right to change my mind (i.e. withdraw from the research) even after I have signed this form.

I voluntarily agree to be part of this research.

Name or Initials of Participant..... ID Code .....

Participants' Signature ..... Date.....

INVESTIGATOR STATEMENT AND SIGNATURE

I have adequately informed the participant and I certify that the purpose, procedures, potential risks and benefits associated with this study have been explained to the above individual to the best of my ability.

Researcher's name.....

Signature .....

Date.....

Appendix C: Questionnaire

Dear participant,

The aim of this study is to examine the knowledge and practice of tuberculosis infection prevention and control measures among nurses and doctors at selected government hospitals in the Accra Metropolis. The questions will require approximately 30-40 minutes for completion. The findings of this research will contribute to improving the measures that nurses and doctors will employ to prevent the spread of TB in health care settings

Thank you.

SECTION A: DEMOGRAPHIC INFORMATION

Please kindly provide answers to the under listed questions. Respond to the items by **ticking (√) or writing** in the spaces provided.

1. Age.....

Please tick age bracket: a. 20 – 25 years ( ) b.26 – 31 years ( ) c. 32 – 37 years ( )

d. 38 – 43 years ( ) e. 44 – 49 years ( ) f. 50 years and above ( )

2. Sex: a. male ( ) b. Female ( )

3. Educational Level: a. certificate ( ) b. Diploma ( ) c. Degree ( ) d. Masters d. PhD ( )

4. Profession: a. Medical doctor ( ) b. Nurse ( )

5. How long have you been practicing as a nurse or doctor?

a. 6 months – 1 year ( ) b. 2 years – 5 years ( ) c. 6 years – 9 years ( ) d. 10 years – 13 years ( ) e.14 years and above ( )

6. Place of work: a. Achimota Hospital ( ) b. La General Hospital ( ) c. Princess Marie Louise Children's Hospital ( ) d. Ridge Hospital ( )

7. Current department/ward/unit of work: please indicate the department/ward/unit you work.....

SECTION B: KNOWLEDGE ABOUT TB INFECTION PREVENTION AND CONTROL MEASURES

Please specify your knowledge about tuberculosis infection prevention and control. Each question requires one answer. Please answer by ticking (√) appropriate response.

1. Which of the following best describes how TB is spread?

a. If uninfected person comes into contact with the blood of a person containing the TB bacilli ( )

b. When TB bacilli droplets become suspended in the air and someone breaths in the TB bacilli ( )

c. A person infected with TB can spread the bacteria through physical contact. ( )

d. When an infected person prepares food and introduces the TB germs into the food. ( )

2. Hospital staff should implement which of the following administrative control measures for TB infection prevention and control? Tick as many as applicable.

a. Prompt identification and separation of coughing patients from others. ( )

b. Promoting cough etiquette ( )

c. "Fast tracking" patients suspected of TB infection for prompt diagnosis and treatment ( )

d. All the above ( ) e. A and B only ( )

3. The examination or treatment room for patients whom you suspect may have TB should have all of the following except:

a. Air exhaust directly to the outside ( )

b. Ventilation solely by air condition ( )

c The placement of the patients nearest the window or fan exhausting the air. ( )

d. Adequate ventilation ( )

4. An easy and low-cost way to reduce the number of infectious TB droplets in the air is to:

a. Use natural ventilation by opening windows and doors and maximizing cross -ventilation ( )

b. Provide respirators or N95 masks to all staff ( )

c. Install a mechanical ventilation system ( )

d. Wash hands with soap and water before and after every patient contact ( )

5. Cough etiquette:

a. Is when someone says "excuse me" after coughing in public ( )

b. Should be required of all patients, but not necessary for healthcare workers ( )

c. Include covering your coughs and sneezes with handkerchief, tissue, or upper arm ( )

d. All of the above ( )

6. If particulate respirators (also known as N-95 or FFP2 masks) are available in your hospital, they should be:

a. Used for all TB patients or persons suspected of TB in the hospital ( )

b. Worn by staff when conducting a bronchoscopy procedure or other high risk procedure for a patient with TB, MDR TB, or XDR TB ( )

c. Required for all staff when they are infected with any infectious disease to prevent transmission to patients ( )

d. Worn by patient when sitting outside to prevent TB droplet from spreading throughout the town ( )

7. What is the most effective intervention for TB control?

a. BCG re-vaccination ( ) b. Chemoprophylaxis ( ) c. Early detection of TB patients ( )

d. Appropriate treatment of TB patients ( ) e. Both C and D ( )

8. In an environment where TB transmission is a risk, surgical mask should be used by:

a. Doctors ( ) b. Nurses ( ) c. Coughing patients ( ) d. Visitors ( ) e. Administrators ( )

f. All the above ( )

Please indicate by ticking whether the following sentences are true/ false.

9. In healthcare setting, the greatest risk for TB spread is by coughing patients who have not been recognized as having TB and are not receiving treatment.

a. True ( ) b. False ( )

10. Small areas with minimal ventilation should be used for sputum collection because they safely contain the TB droplets.

a. True ( ) b. False ( )

11. Managerial control measures for TB infection control include instituting screening of health care workers on TB.

a. True ( ) b. False ( )

SECTION C: TB INFECTION PREVENTION AND CONTROL TRAINING

This section gathers information with regards to training you have received on tuberculosis infection prevention and control.

C.2.a Have you ever attended a tuberculosis infection prevention training program for the past 3 years please? Please tick (√): Yes ( ) No ( )

C.2.b If yes, please indicate by ticking how many times in the last 3 years

a. once ( ) b. twice ( ) c. thrice ( ) d. several times ( ), please indicate number of times.....

C.2.c Please indicate the usefulness of the training by ticking ( ) from options below

Extremely useful (√) Very useful ( ) Moderately useful ( ) Not useful ( )

SECTION D: PRACTICES FOR PREVENTING TUBERCULOSIS INFECTION

This section gathers information relating specifically to your practice with regards to Tuberculosis infection prevention and control (including training you have received, administrative and environmental controls as well as personal protective equipment)

D.1 Please indicate how often the following statements apply to you. Please tick (√) one response in the table provided below.

Statement	Always	Sometimes	Rarely	Never
(a) I use information, education and communication (IEC)materials such as posters to educate and increase patients awareness on TB				
(b) I educate coughing patients to apply cough etiquette (cover mouth, nose with mask, tissue, handkerchief or coughing into arms)				
(c) I separate or "fast track" patients who are identified as TB suspects from other patients in waiting areas.				
(d) In the wards I separate or group suspected or confirmed TB patients from other patients				
(e) I educate suspected TB patients to wash their hands anytime they produce respiratory secretions.				
(f) I wear N95/FFP2 mask when working in high risk TB areas example (direct observed therapy short course (DOTS) room, TB microscopy room, TB wards)				
(g) I offer surgical mask to TB suspects or cases when they are in the hospital.				
(h) I practice hand hygiene anytime I come into contact with patients with respiratory secretions or carry out other procedures.				

D.2 Please indicate the extent to which you **agree or disagree** with the following statements below. **Tick (√)** your responses in the table below. One response for each item is appropriate.

Statement	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
a. In my workplace I have access to resources to prevent TB infection such as hand hygiene items, surgical mask andN95					
b. Patients visual alerts example Posters advising patient to inform staff if they have respiratory symptoms are available at all vantage points in my facility.					
c. My facility has set up quick turnaround times for TB cases					
d. The windows and doors in my facility are opened daily for maximum cross ventilation.					
e. Sputum microscopy is done in a designated area rather than in the main laboratory.					
f. Patients with active TB are most often admitted to the same ward with other patients.					
g. Propelling fans example (ceiling fans) and air conditioners are most often used in my facility than natural cross ventilation.					
h. Ceiling fans are functioning, cleaned and in good condition all the time.					

SECTION E – CHALLENGES

a) What are some of the challenges you encounter in the implementation of TB infection prevention and control strategies or measures in your facility?

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Thank you for your participation

SECTION E – CHALLENGES

a) What are some of the challenges you encounter in the implementation of TB infection prevention and control strategies or measures in your facility?

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Thank you for your participation

Appendix D: Ethical Clearance

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Tel: 233-302-681109
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Email: [illegible]
[illegible] April, 2019

My Ref: GHS/RDD/ERC/[illegible]
Your Ref. No.

Esther Anome Osei-[illegible]
University of Ghana
School of Public Health
Legon

The Ghana Health Service [illegible] approval for the [illegible] your Study Protocol.

GHS-ERC Number	GHS-ERC 024/03/19
Project Title	Knowledge and Practice of Infection [illegible] Prevention [illegible] Measures among Nurses and Doctors at Selected Government Hospitals Accra, Ghana
Approval Date	1st April, 2019
Expiry Date	31st March, 2020
GHS-ERC Decision	Approved

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months
- [illegible]