SCHOOL OF PUBLIC HEALTH

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ASSESSMENT OF IMPLEMENTATION OF TUBERCULOSIS INFECTION CONTROL MEASURES AMONG HEALTH CARE WORKERS AT THE GREATER ACCRA REGIONAL HOSPITAL

BY

PORTIA DZIVENU

(10279244)

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DECLARATION

I, Portia Dzivenu, do hereby declare that with the exception of references made to other people's work and textbooks which have been duly acknowledged, this dissertation is my original work. I affirm that this work has neither been published in whole or part to any institution for any academic award.

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Date: 06-01-2017

Portia Dzivenu

(Student)

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Date: 6/01/2017

Dr. Patricia Akweongo

(Academic Supervisor)

DEDICATION

This piece of work is dedicated to the Almighty God for His sustenance and provision, Nana Kwame Koranteng and Dr. & Mrs. Steele-Dadzie for their unwavering support.

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"Now thank we all our God...With countless gifts of love, and still is ours today."

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ABSTRACT

Background: Tuberculosis has become a global burden and of public health importance. Health care workers in developing countries are highly susceptible to workplace associated TB infection due to the long hours spent with patients who have undiagnosed or untreated TB cases, poor infection control measures and poor isolation of TB cases in health care facilities.

Objective: To assess the implementation of tuberculosis infection control measures among health care workers at the Greater Accra Regional Hospital.

Methods: Descriptive cross-sectional study design using both quantitative and qualitative approach was employed in this study. One hundred and thirty seven (137) Health Care Workers (HCWs) and seven (7) Key Informants participated in the study. The HCWs were proportionally selected from each job category using simple random sampling technique. Quantitative data were obtained using semi-structured questionnaires, and triangulated with direct observation and Key Informant Interviews. Descriptive analysis, univariate and multivariate logistic regression were carried out using STATA version 14.0. Qualitative data were transcribed verbatim and analyzed using thematic analysis.

Results: More than half, 88 (64.2%) of the HCWs exhibited good knowledge, while a similar proportion 83 (60.6%) also exhibited good practice. Being female (COR= 2.06, 95% CI: 1.00-4.22) and married (AOR= 3.19, 95% CI: 1.11-9.13) were significantly associated with knowledge. Having good knowledge (AOR = 5.83, 95% CI: 2.07-16.43) and being a Doctor (AOR= 7.91, 95% CI: 1.73-36.18) were significantly associated with

good practice. Qualitative data showed that HCWs perceived screening of patients as the main promoter of effective implementation of Tuberculosis Infection Control (TBIC), while inadequate Personal Protective Equipment (PPEs), absence of staff screening, small waiting area and improper ventilation were the major inhibitors.

Conclusion: The overall level of knowledge and practice was good among HCWs. Knowledge and job category were the main significant predictors of TBIC practice. Sustained TBIC practice was perceived to be largely promoted by availability of screening of suspected TB patients, while inadequate PPEs and absence of staff screening for TB were perceived to be the major inhibitors. Hence, facility management should work closely with the TB Coordinator to ensure periodic staff screening exercise and provision of needed logistics.

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LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
AMA	Accra Metropolitan Assembly
AOR	Adjusted Odds Ratio
ART	Antiretroviral Treatment
CDC	Center for Disease Control
COR	Crude Odds Ratio
DOTS	Directly Observed Treatment Short Course
ERC	Ethical Review Committee
FFP2	An oil and non-oil aerosol mask or respirator with 94% filter efficiency that protects from inhaling infectious droplet nuclei
GARH	Greater Accra Regional Hospital
GHS	Ghana Health Service
GSS	Ghana Statistical Service
HCWs	Health Care Workers
HIV	Human Immune Virus
MDGs	Millennium Development Goals

MOH	Ministry of Health
NTP	National Tuberculosis Programme
N95	A non-oil close fitted mask with 95% filter efficiency that protects from inhaling droplet uclei
OPD	Out Patient Department
PPE	Personal Protective Equipment
KIIs	Key Informant Interviews
SDGs	Sustainable Development Goals
TB	Tuberculosis
TBIC	Tuberculosis Infection Control
UNO	United Nations Organization
UVGI	Ultraviolet Germicidal Irradiation
WHO	World Health Organization

OPERATIONAL DEFINITION OF TERMS

Knowledge: Information and understanding of health care workers concerning TB and its control measures.

Practices: Attitudes and activities of health care workers towards controlling TB transmission at the Greater Accra Regional Hospital.

Tuberculosis Infection Control: The necessary actions or precautionary measures put in place to reduce the spread of Mycobacterium tuberculosis from one person to another.

CHAPTER ONE

INTRODUCTION

1.0 Background

In health care settings, TB spreads from patients to health care workers and other users of the facility (Sissolak, Marais, & Mehtar, 2011). The World Health Organization in 2016 reported a global TB incidence of 10.4 million (5.9 million men, 3.5 million women and 1 million children) with an incidence rate of 142 per 100,000 populations in 2015. Africa recorded an incidence of 2.7 million with an incidence rate of 275 per 100,000 populations. This was the highest incidence rate amongst all the six WHO regions. Ghana, however, recorded an incidence of 44,000 with an incidence rate of 160 per 100,000 populations (WHO, 2016).

The global mortality of TB was 1.4 million with a mortality rate of 19 deaths per 100,000 populations. In Africa, 450,000 deaths were recorded with a mortality rate of 45 per 100,000 populations. Again, Africa had the highest rate amongst all the six WHO regions. Ghana recorded 10,000 deaths with mortality rate of 37 per 100,000 populations (WHO, 2016).

In 2015, an incidence of 9,977 was recorded among Health Care Workers (HCWs) in 67 countries, of which South Africa emerged as the second highest, recording 2,095 cases (WHO, 2016). A report by Ghana's National Tuberculosis Programme in 2011 revealed that about three hundred health care workers (HCWs) in Ghana were infected with tuberculosis (NTP, 2011, unpublished data).

A Meta-analysis revealed that health care workers have three times (3x) average annual risk of tuberculosis infection than the general population across all settings (Baussano et al., 2012). In three districts in Kwazulu-Natal, South Africa, 112 TB cases were detected among 1,313 health care workers studied (Tudor et al., 2014). A study in Kigali, Rwanda showed that out of every three health care worker, almost two were infected with nosocomial TB infection (Rutanga et al., 2015).

The spread of Mycobacterium tuberculosis in health facilities to both patients and health care workers may be due to poor infection control practices within the facilities. Additionally, the long waiting time spent by patients in various health facilities is a contributory factor to the high rate of tuberculosis in health care settings (Escombe et al., 2010). This is because patients with undiagnosed or untreated TB mingle with other patients and health care workers thereby increasing their risk of infection.

Implementation of infection control measures as an essential component of health care provides the basis for TB risk reduction among health care workers, patients and other facility users. The WHO, in a bid to achieve this, established an implementation guideline, which was updated in 2009 to curb TB infection in health care settings. The objective of the program was to ensure prompt detection of infectious patients, airborne precautions and treatment of people with suspected or confirmed TB (WHO, 2009).

The policy covers managerial/administrative, environmental and personal protective measures. The managerial and administrative measures are the first and most important level in TB infection prevention and control (Chen et al., 2016). It focuses on reducing the droplets of Mycobacterium tuberculosis in health care settings by eliminating its generation

and risk of exposure. Environmental measures seek to provide an infection free environment for both health care workers and users by preventing spread as well as reducing the concentration of the TB bacterium in the air. The third level, which is the personal protective measures, involves the use of respirators to protect users from inhaling the Mycobacterium tuberculosis. It serves as the last line of defense in the event of failed managerial/administrative and environmental protective measures (WHO, 2009). The implementation of Tuberculosis Infection Control (TBIC) is largely dependent on health care workers because of their role as front liners in health service delivery. However, studies have confirmed that such a function has greatly been limited in many health facilities due to poor knowledge, poor training of health care workers on the implementation of TBIC and insufficient provision of personal protective equipment amongst others (Baussano et al., 2012).

This study therefore sought to assess the implementation of Tuberculosis Infection Control measures among health care workers at the Greater Accra Regional Hospital using both quantitative and qualitative research approach.

1.1 Problem Statement

In Ghana, about 300 health care workers (HCWs) were infected with tuberculosis in 2011 (NTP, 2011, unpublished data). It has been identified that poor ventilation and air recirculation alongside poor infection control and isolation practices are often contributory factors to TB transmission in health care setting (Castela, Silva, Ferreira, & Nienhaus, 2011). Long waiting time of patients with undiagnosed and untreated TB cases at health

facilities also increases health care workers' susceptibility to TB infection (Heysell, Shenoi, Thomas & Friedland, 2011).

Infection control is regarded as a critical preventive measure in TB care. In 2009, the WHO revised the guidelines for the implementation of TB Infection Control (TBIC) in health facilities to protect other patients and to reduce TB risk among health care workers (WHO, 2009). Ghana's Ministry of Health (MOH) also adopted and implemented the WHO TBIC policy due to the heightened concerns about unacceptable infection control practices throughout the country (MOH, 2009).

The implementation of the Tuberculosis Infection Control (TBIC) is largely dependent on health care workers' knowledge, attitudes and practices. Unfortunately, many health care workers perceive it as a burden due to work overload and the use of personal protective measures as uncomfortable thereby posing challenges to implementing TBIC (Efstathiou, Papastavrou, Raftopoulos, & Merkouris, 2011).

A national survey in Ghana by Amo-Adjei (2013) revealed that health system factors such as poor funding, poor infrastructure, friction between clinicians and public health professionals, weak monitoring and evaluation practices were some of the barriers to effective implementation of TBIC. A study at the Tema General Hospital by Codjoe (2012) also showed lack of wards for isolating TB patients, lack of protective equipment and overcrowding of patients at Out Patient Department (OPD) and inadequate training as factors hindering implementation of TBIC in the facility. Another study in Urban Takoradi Ghana reported that isolation of TB wards in addition to "excessive" use of PPEs (gloves) by health professionals when attending to TB patients served as basis for stigmatizing

against the patient (Dodor & Kelly, 2010). As such, isolation of TB patients was not effectively practiced. The quality of environmental factors and service factors (frequency of screening, availability of TBIC materials, availability of TB laboratory for testing and reporting) influencing the implementation of TBIC are however unknown.

Thus, this study sought to assess the practices of Health Care Workers (HCWs) on Tuberculosis Infection Control (TBIC), and explore service factors and environmental factors influencing its implementation at the Greater Accra Regional Hospital using a mixed method approach.

1.2 Conceptual Framework on Implementation of TBIC

Figure 1 below shows the relationship between the various aspects of implementation of Tuberculosis Infection Control (TBIC) among health care workers. These factors include facility-level managerial activities alongside administrative, environmental and personal protection measures.

Facility-level managerial activities comprise the systems in place to ensure appropriate set up and implementation of the three aforementioned TBIC measures at the facility level. It includes leadership, planning, coordinating activities and groups, monitoring and evaluation, development of policies and procedures, facility assessment, and participating in research works in line with the national TB agenda. It is usually fused into the administrative measures.

Administrative Measures is the first line of defense for the implementation of TBIC (Menon, 2013). It focuses on preventing droplet nuclei containing mycobacterium

tuberculosis from being generated in the facility thereby reducing exposure of patients and health care workers to TB. It therefore requires prompt identification of TB suspects (triaging), separation and treatment of people with TB symptoms, and minimizing time spent in health care facilities. These measures tend to influence both the environmental and personal protection measures.

Administrative and managerial factors can be grouped into two; service factors, and human resource and leadership factors. Service factors are factors directly linked with TB care. These include availability of TBIC materials, availability of TB laboratory for testing and reporting, frequency of TB screening, and availability of an isolation ward for separation of infectious patients. Availability of TBIC materials such as TBIC plan, policies and procedures, PPEs and Information, Education, Communication (IEC) materials may enhance sustained implementation of TB Infection Control among HCWs. They know what is expected of them and how to go about it in order to reduce TB infection in the health care facilities.

The human resource and leadership factors are factors that indirectly affect the quality of the implementation of TBIC measures among health care workers. These include training of HCWs on TBIC, education of patient on cough etiquettes and respiratory hygiene, and supervisory activities. These factors reduce TB transmission in health care settings by making health care workers conscious of TB related issues and the appropriate ways to handle them while proper supervision ensures effective implementation of TBIC Measures.

Environmental Measures include ways of reducing the concentration of Mycobacterium TB droplet nuclei in the air and controlling the direction of the infectious air (WHO, 2009).

It is largely tailored towards ensuring quality ventilation system, which in turns reduces TB infection in health facilities. An effective administrative and facility-level managerial activity is key to ensuring proper environmental measures since the administrative and managerial activities are responsible for the provision of the ventilation equipment.

Personal Protective Measures involves the use of Personal Protective Equipment (PPEs), like particulate respirators and masks, to protect HCWs from TB infection. It is used together with the administrative measures and facility-level managerial activities, and environmental measures where there is an increased risk of transmission (WHO, 2009). Adequate provision of personal protection equipment as well as training on its appropriate use may encourage usage among health care workers (WHO, 2009). It has been shown that many HCWs are unclear about the use of respiratory protection in terms of when, how and which type is needed in specific situation (Peterson, Novak, Stradtman, Wilson, & Couzens, 2015). Effective supervision may also reduce the rate of non-compliance to the use of personal protection equipment among HCWs.

CONCEPTUAL FRAMEWORK OF TUBERCULOSIS INFECTION CONTROL

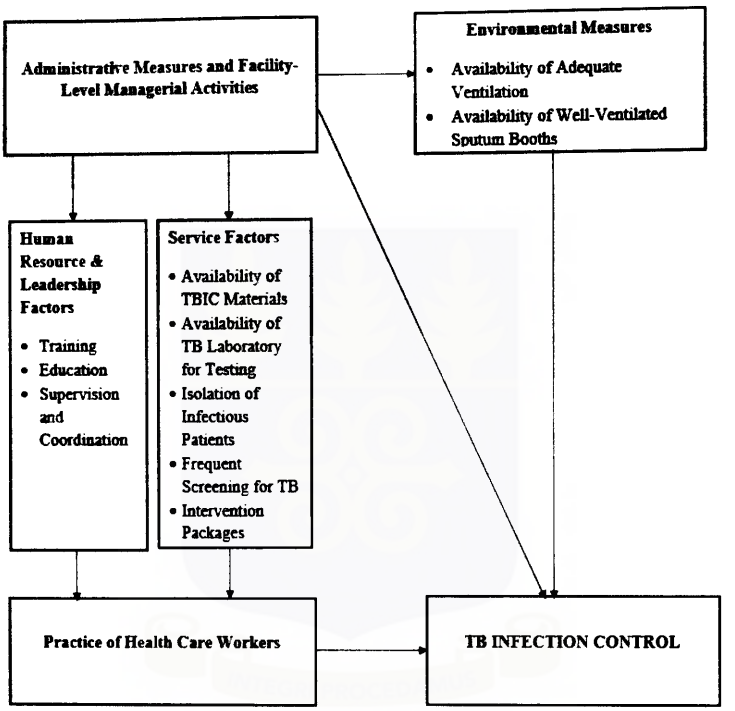

Figure 1.1: Conceptual Framework on Tuberculosis Infection Control

1.3 Justification

Improved infection control measures have been shown to be effective in preventing tuberculosis transmission within health care settings. Thus, this study will provide quantitative and qualitative data on the implementation of Tuberculosis Infection Control (TBIC) measures among health care workers at the Greater Accra Regional Hospital, Ghana. This would inform policies on tuberculosis infection control as the challenges health care workers face in implementing TBIC would be unearthed. It would also provide recommendations to health facility heads on health service delivery factors needed to support health care workers in implementing TBIC. This study would also unearth the practices of health care workers in implementing the tuberculosis infection control measures, which may enable facility heads to undertake effective monitoring and evaluation to reduce nosocomial TB transmission among health care workers, patients and relatives.

1.4 Research Questions

1. What is the level of knowledge and practice of health care workers on TB infection control?
2. What service factors are influencing the implementation of TBIC among health care workers?
3. What are the environmental factors influencing the implementation of TBIC among health care workers?

1.5 Objectives of the Study

This section outlines the general and specific objectives of the study.

1.5.1 General Objective

To assess the implementation of Tuberculosis Infection Control (TBIC) measures among Health Care Workers at the Greater Accra Regional Hospital.

1.5.2 Specific Objectives

1. To assess the level of knowledge and practice of health care workers on TB infection control
2. To explore the service factors influencing the implementation of TBIC
3. To describe the environmental factors influencing the implementation of TBIC

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter provides an overview of previous research on Tuberculosis (TB) and Tuberculosis Infection Control (TBIC) measures. It highlights the following themes tuberculosis epidemiology, TB infection in the health care settings, TB infection, prevention and control strategies, Health Care Workers' (HCWs) practices of TBIC policies and measures, and Challenges faced by HCWs in the implementation of TBIC measures.

2.1 Tuberculosis Epidemiology

Tuberculosis is a major global health problem and of public health concern. According to the World Health Organization, in 2015, TB ranked (above HIV/AIDS) among the top ten causes of death worldwide (WHO, 2016). Despite the numerous measures employed to militate against this infectious disease, in 2015, the new cases of TB recorded globally were about 10.4 million, comprising 5.9 million men, 3.5 million women, and 1.0 million children (WHO, 2016). The global incidence rate was 142 per every 100,000 populations. The WHO South-East Asia Region recorded an estimated incidence of 4,740,000 TB cases, with an incidence rate of 246 per 100,000 populations. The WHO African Region, with total incidence of 2,720,000 cases, recorded the highest incidence rate of 275 per every 100,000 populations (WHO, 2016).The incidence in Ghana was 44,000 cases with an incidence rate of 160 per every 100,000 populations.

In terms of mortality, an estimated 1.4 million TB deaths were recorded in 2015 globally. Sixty percent (60%) of these deaths were recorded in six (6) countries only: India,

Indonesia, China, Nigeria, Pakistan and South Africa. The global mortality rate was 19 deaths per 100,000 populations. The WHO African Region alongside WHO South-East Asia recorded the highest total deaths in 2015 (an estimated 450,000 and 710,000 deaths respectively). In terms of mortality rate, the African Region recorded the highest rate of 45 per every 100,000 populations followed by the South-East Asia Region with a rate of 37 deaths per every 100,000 populations. Ghana recorded about 10,000 deaths with a mortality rate of 37 deaths per 100,000 populations (WHO, 2016). This makes TB a poverty-related disease, mainly affecting the poorest regions in the world.

2.2 Tuberculosis Infection in the Health Care Settings

The risk of contracting the Mycobacterium tuberculosis increases with the frequency of contact with people infected with the disease. This makes health care settings one of the most common locations for TB transmission. The risk of exposure to TB in health care facilities increases as health-care facilities become overcrowded with undiagnosed and infectious TB patients who spend long hours waiting to receive medical care. Improper environmental infection control due to poor ventilation, and poorly enforced TB infection prevention and control measures are among the contributory factors to health care setting TB infection (Grobler et al., 2016).

In 2009, the WHO reported that the TB incidence rate of people working in health care settings was higher than that of the general population (WHO, 2009). In a bid to mitigate this, the WHO also came out with a policy on TB infection control in health-care facilities, congregated settings and household. The objective of the policy is to "*provide Member States with guidance on how to reduce the risk of TB transmission in healthcare facilities,*

congregate settings and households, and how to prioritize TB infection control measures" (WHO, 2009). In 2015, an incidence of 9,977 cases among health-care workers were reported from 67 countries, with China and South Africa accounting for 31% and 21% of these cases respectively (WHO, 2016). A research by Adams and colleagues reported that generally, health care facilities in South Africa have less adequate or inappropriate infection prevention and control measures established to protect their employees (Adams et al., 2013), despite the international policy recommendations to mitigate TB in such settings (WHO, 2010). In Ghana, however, about 300 health care workers were infected with tuberculosis in 2011 (NTP, 2011 Unpublished data).

2.3 Infection Prevention Control in Health Care Settings

Nosocomial infections, also known as "healthcare-associated infections," are the infections that occur due to prolonged patient stay in health facilities (Brusaferro et al., 2015). These infections could be picked from other patients, equipment and even through the air. It can increase the length of stay of patients in hospital thereby increasing hospital cost and prolonging recovery.

Infection Prevention Control (IPC) has been shown to be of utmost importance in health care settings and in healthcare because of its potential benefit in reducing the burden of disease on patients, facilities and the nation at large. Thus, health care organizations are taking pragmatic steps to improve the prevention and control of nosocomial infections.

In, 2009, the Ministry of Health in Ghana revised its IPC policy with focus on improving environmental health and other hygienic measures in health care settings. It recommended that all facility based infection prevention control programmes should be fused with other

important programmes such as TB programmes, quality assurance, environmental and occupational health, communicable disease control among others (MOH, 2009). Previous study has shown that isolation precautions are essential in reducing transmission of infectious agents within health care settings (Raka, 2010).

2.4 Tuberculosis Infection, Prevention and Control Measures

Tuberculosis is a leading cause of morbidity and mortality globally, especially amongst developing countries (Zaman, 2010). Due to TB's global impact, various measures and policies have been developed over the years to fight it. The quest to end epidemics including TB is now a prominent part of strategies developed by global bodies, including the United Nations Organization (UNO) and the World Health organization (UNO, 2015; WHO, 2016).

The Directly-Observed Therapy Short course (DOTS) has been a leap forward in controlling tuberculosis. It has become the basis for treating TB in many countries.

From the year 2000 to 2015, two major global measures were implemented to reduce the burden of TB: the Millennium Development Goals (MDGs) (2000 – 2015) that sought to "halt and reverse" TB incidence by 2015 (MDG 6, Target 8), and the Stop TB Strategy (2006-2015) by focusing on halving TB prevalence and TB mortality by 2015 compared with their levels in 1990, in addition to achieving the MDG target. According to WHO, the MDG target was achieved on a world-wide basis. Further, there was a 47% fall in global TB death rate between 1990 and 2015, with most improvement occurring after 2000. It also indicated that the prevalence rate fell by 42% between the same periods (WHO, 2016). After 2015, the UN initiated the Sustainable Development Goals (SDGs) – from 2016 to

2030 - and the WHO is implementing the End TB Strategies (2016-2035). Target 3.3 of the Sustainable Development Goal 3, focuses on ending epidemics - including tuberculosis - by 2030 (UN, 2015). The WHO End TB Strategy also seeks to reduce TB deaths by 95% and TB incidence by 90% from 2015 to 2035. The overall goal is to reduce incidence to 10 new cases per 100,000 populations (WHO, 2016).

Tuberculosis infection control involves employing diverse "measures aimed at minimizing the risk of TB infection transmission within populations" (WHO, 2009). It involves early and rapid diagnosis, and proper management of TB patients. As part of the WHO's Stop TB Strategy, a policy for the implementation of sound TB infection control, with focus on control in health-care facilities and congregated settings and households, was introduced in 2009 and adopted by Ghana's Ministry of Health. The policy covers three main levels of controls: Administrative Measures, Environmental Measures, and Personal Respiratory Protection. It also covers managerial activities that facilitate the implementation of these controls.

2.4.1 Administrative measures

Administrative Measures is the first line of defense for the implementation of TBIC in any setting regardless of available resources (Menon, 2013). They are the most effective and least expensive intervention (Nardell & Dharmadhikari, 2010). It focuses on preventing droplet nuclei containing mycobacterium tuberculosis from being generated in the facility thereby reducing exposure of patients and health care workers to TB. It therefore requires prompt identification, separation of infectious patients, control of spread of pathogens, and

treatment of people with TB symptoms, while minimizing time spent in health care facilities (WHO, 2009).

2.4.2 Environmental measures

Environmental Measures aim to reduce the concentration of TB droplet nuclei in the air and ways to control the direction of infectious air (WHO, 2009). It usually starts with construction of buildings, renovations and maintenance works, thereby reducing the risk of nosocomial TB infections that result from over-crowded wards in high-burden settings. Environmental measures could be natural or mechanical/ artificial ventilation system. Simple natural ventilation is achieved by proper window sizes, and locating them on opposing walls (WHO, 2009). It is considered as a low maintenance, low cost and the most effective airborne infection control measure. As such, it is recommended in low-resourced settings in warm climates (Escombe et al., 2007; Shenoi, Escombe, & Friedland, 2010). Mechanical ventilation in the form of fans could also be employed when natural ventilation alone is not sufficient. Besides, ultraviolet germicidal irradiation (UVGI) fixtures may be used (WHO, 2009). The UGVI is climate independent, and as such addresses the limitation of natural ventilation (Shenoi et al., 2010). However, it requires skilled architects for its proper installation (Nardell & Dharmadhikari, 2010). Environmental Measures is largely influenced by resource availability making its effective implementation challenging in many low- resourced settings. However, proper staff training on the correct use of these measures and proper maintenance is shown to be beneficial.

2.4.3 Personal Respiratory Protection Measures

Personal Protection Measures involves the use of personal protective equipment in instances when there is increased risk of transmission (Jensen, Lambert, Iadermarco, &

Ridzon, 2005). This may be in the form of particulate respirators or surgical masks. The respirators are recommended for health care workers directly involved in TB care as well as other facility users who encounter TB patients, while patients or people suspected to be infected with TB are advised to use surgical masks for proper coughing etiquettes. The WHO recommends particulate respirators that has standards equivalent to or exceeding N95 standard or FFP2 standard for US and Europe respectively (WHO, 2009). The personal protective measures complement HCWs level of protection after the administrative and environmental measures have been implemented. Constant provision of quality Personal Protective Equipment (PPE) coupled with adequate training for its use highly influences implementation of TBIC measures. However, previous literature reports that fit-testing of PPEs is neglected (Nardell & Dharmadhikari, 2010).

2.5 Health Care Workers' Knowledge and Practices towards the implementation of TBIC Measures

Health Care Workers (HCWs) play a very important role in the success or failure of TBIC measures due to their frontline functions. An effective tuberculosis infection control will require that HCWs properly implement the various TBIC measures, and also educate TB patients and the community about basic control measures like adequate ventilation, cough hygiene, etc. As such, it is very necessary that they have adequate awareness and level of knowledge of the TBIC measures. A study in Northwest Ethiopia from August 2010 to January 2011 indicated that health professionals with good knowledge were ten (10) times more likely to practice TBIC compared to those with poor knowledge (Temesgen & Demissie, 2014). According to Demissie Gizaw, Aderaw Alemu, & Kibret (2015), tuberculosis training and work experiences are major contributory factors to knowledge,

while TB related training and experiences are significant pointers to practice. A study in Russia showed that knowledge level of health care workers could influence the prevalence of TB infection (Woith, Volchenkov, & Larson, 2012).

Nonetheless, previous researchers have found that HCWs often lack adequate knowledge about TBIC. According to the study of selected health care workers in northwest Ethiopia by Temesgen and Demissie, "though the majority of the participants had good TBIC knowledge and practice, a considerable proportion of health professionals were not trained on TBIC" (Temesgen & Demissie, 2014). In 2013, a study by Minnery and his colleagues on the knowledge and attitudes of front-line TB personnel in Lima, Peru, also showed that there were major knowledge gaps in areas related to TB treatment and diagnosis, which reflected other previous findings in TB endemic areas throughout the world (Minnery et al., 2013).

Tuberculosis Infection Control (TBIC) involves employing diverse measures aimed at minimizing the risk of TB transmission within populations (WHO, 2009). The WHO recommended a combination of measures – including administrative measures, environmental measures, and personal respiratory protection – to reduce TB infection (WHO, 2009). Effective TBIC implementation requires early identification, isolation of infected persons, and timely, effective treatment of persons with TB. Gaps in the implementation of TBIC predispose health care workers and patients to nosocomial TB transmission (Temesgen & Demissie, 2014).

However, TBIC is rarely effectively implemented in most developing countries due to resource constraints. A study of two districts in Uganda showed that TBIC measures were

not being implemented. It identified factors like lack of staff, space and funds as barriers to the implementation of TBIC (Buregyeya, Mitchell, Rutebemberwa, Criel, & Kiguli, 2013).

According to Temesgen and Demissie, "a rapid assessment done in 2008 revealed that most health care facilities in Ethiopia do not use TBIC practices," exposing both health care workers and patients to TB transmission, especially at facilities with high case load (Temesgen & Demissie, 2014). Another research shows that a significant portion of HCWs had unsatisfactory practice on TBIC (Demissie Gizaw et al., 2015).

2.6 Factors Influencing the Implementation of TBIC Measures

Tuberculosis, although a curable disease, remains a major health problem globally despite the various measures introduced by the World Health Organizations and other international bodies and groups (WHO, 2016). There are many challenges that many times beset the implementation of the tuberculosis infection control. These include clinical, institutional, and socio-cultural factors. Previous studies also identify other barriers such as delays in diagnosis, inadequate financial support, insufficient motivation, lack of clear guidelines, shortage of materials, inadequate qualified health professionals and inadequate health care worker training (Cramm, Finkenflügel, Møller, & Nieboer, 2010; Amo-Adjei, 2013; Buregyeya et al., 2013; Brouwer, Coelho, Das Dores Mosse, et al., 2014; Wynne, Richter, Banura, & Kipp, 2014).

Inadequacy of qualified health professionals coupled with poor training programs is a major hindrance to effective implementation of TBIC. According to Wynne and colleagues (2014), health providers in Western Uganda are unable to effectively implement TB control

programs due to inadequate qualified health professionals and poor health care worker training. There were health facilities that had only one health professional with proper training on TB, and other workers relied on outdated materials from school. The inadequacy of knowledge results in extensive delays in diagnosing patients, and in some cases, failure to even identify the signs and symptoms to screen the patients (Wynne et al., 2014). Further, Buregyeya et al., (2013) also identified lack of human resource (understaffing) as a limiting factor to effective implementation of TBIC. It was again reported that TBIC measures like screening for people with cough, timely sputum examination, and health education were perceived as extra workload for the already overstretched personnel (Tamir, Wasie, & Azage, 2016). As such, screening was not done at the point of arrival of the patients.

In Mozambique, it was recorded that although some TB staff went through formal TB training, the auxiliary staff were not partaking in such trainings even though they often assisted with patient-related activities (Brouwer et al., 2014). Other researchers showed that the practicality of some of the training programs also was inadequate. They revealed that training was not identified to have an influence on TBIC practice in many public health facilities in Ethiopia, indicating that it could be a result of much focus on the theoretical components of the training instead of the skill-based aspects (Temesgen & Demissie, 2014; Demissie Gizaw et al., 2015).

A study across 3 districts in South Africa revealed lack of training, poor compliance, absence of TBIC plan and committee, dire shortage of respirators as hindrances (Engelbrecht & Van Rensburg, 2013) . Also, implementation and practice of TBIC in facilities in Ikeja, Nigeria was poor due to barriers such as non-existence of TBIC plan,

lack of training, shortage of manpower, stigmatization and structural inadequacies (Kuyinu et al., 2016).

Inadequate funding for TB control programs is also a challenge to effective implementation of TBIC by health care workers. In Uganda, it was recorded that lack of adequate and consistent funding meant that health care workers were also limited in undertaking community visits and effective follow ups on patients. Logistics and medication were also inadequate and a significant portion of the financial burden was transferred to the patients, who mostly are unable to follow up with the routine (including the regular visits to health care facilities) drawn for dealing with the disease (Wynne et al., 2014). These factors, amongst others, frustrated health professionals' ability to implement the DOTS program. Amo-Adjei (2013) indicated that inadequacy of funding coupled with delays in accessing funds from donors and the government was a barrier to effective TBIC implementation by some institutions in Ghana.

Another barrier to effective implementation of TBIC is the lack of adherence of patients. Patients were identified as not complying with cough etiquette and separation process (Buregyeya et al., 2013). A common pattern realized by Wynne et al., (2014) was the attempts of patients to engage in self-treatments for initial cough symptoms till infection is worsened before a visit is made to hospitals. These factors contribute to extensive delays in diagnosis and overcrowding in health care facilities, thereby increasing the risk of transmission. Brouwer and Collegues also identified that patients' daily routine was also a challenge faced by HCWs to effective implementation of TBIC measures. There were certain measures some patients could not adhere to due to their everyday routines like

eating meals together as a family, which made it difficult to separate infected persons from the family during these routines (Brouwer et al., 2014).

To add to the above, many researchers have identified flaws in the healthcare system as a challenge faced by health care workers in implementing TBIC measures. The study by Brouwer and colleagues (2014) revealed that in Mozambique, the healthcare system, including availability of necessary logistics and the infrastructure, was a main hindrance to the use of TBIC measures both by HCWs and patients. There was also shortage of materials like boots, respirators, and other equipment, leading to indifference and poor attitude towards use of respirators. It also showed that there were inadequate spacing of consultation and waiting rooms, coupled with poor ventilation systems including defective windows and doors (Brouwer et al., 2014). Also, according to Buregyeya et al., (2013), health professionals in some districts in Uganda also cited lack of space in waiting area to ensure that TB suspects are separated is a challenge. Wynne and colleagues in their study also identified other health system issues like "poor referral practices between health units" and absence of laboratory capacity to test for TB in many health facilities as a challenge (Wynne et al., 2014). Health professionals were therefore unable to test or diagnose patients even when they suspect an infection. Further, low motivation of HCWs due to low pay, lack of control over career development and inadequate work conditions, has been identified as a challenge to TBIC implementation (Brouwer et al., 2014).

2.7 Measurement of Levels of Knowledge and Practice of HCWs on TBIC

Generally, Health Care Workers' (HCWs) levels of knowledge and practices have been categorized into either good/adequate/proper or poor/improper in many studies. A cross-sectional study by Buregyeya and colleagues (2016) among HCWs in Uganda, used a cut-

off of >70% to indicate "adequate" knowledge levels (Buregyeya, Kasasa, & Mitchell, 2016). Another study which assessed knowledge and practice of HCWs in Ethiopia, considered respondents with scores equal or above the mean as having "good knowledge/practice" and vice-versa (Demissie Gizaw et al., 2015). In West Gojjam Zone, Northwest Ethiopia, participants who scored 80% or more were considered to have had "proper TBIC practice levels " (Tamir et al., 2016). Furthermore, another research used ≥60% for assessing "good knowledge" while for "good practice" ≥50% was used (Temesgen & Demissie, 2014). A South African study considered higher knowledge scores as suggestive of "greater knowledge" (Cramm et al., 2010). Thus, in this study, the measure of knowledge will be scoring equal to or above the mean (7.8) for "good knowledge" and below the mean for "poor knowledge." The measure of practice will be ≥ 5.9 for "good practice" and < 5.9 for "poor practice."

2.8 Summary of Literature Review

This chapter explored the relevant literature on implementation of tuberculosis infection control (TBIC) among health care workers. It recognized the various aspects of implementation of TBIC among HCWs as stipulated by WHO in 2009, and identified the following levels of implementation of TBIC measures: Administrative and Managerial measures, Environmental Measures, and Personal Protection Measures. It also showed large gaps in training programs for HCWs, availability of TBIC materials (policy, guidelines, Information, Education and Communication materials, etc.) and PPEs, quality of environmental measures such as isolation rooms for TB patients, ventilation and infrastructural facilities.

CHAPTER THREE

METHODS

3.0 Introduction

This chapter describes the methods employed for the study. It details the study design, study area, study population, variables and sampling procedure. It also covers data storage and protection, quality control, pre-testing of tools, data analysis and ethical considerations.

3.1 Study Design

The study was cross-sectional in design using mixed-methods to collect information on the implementation of Tuberculosis Infection Control (TBIC) among health care workers at the Greater Accra Regional Hospital. The use of quantitative and qualitative methods provide broad and in-depth understanding of the phenomenon being studied (Johnson, Onwuegbuzie, & Turner, 2007). The mixed-method approach involved structured interviews, direct observation and Key Informant Interviews (KIIs). This was to enhance accuracy and triangulate information received from the participants.

3.2 Study Area

The study was conducted at the Greater Accra Regional Hospital in the Accra Metropolitan Assembly area in the Greater Accra Region. Greater Accra Region is one of the ten administrative regions of Ghana. It was reported to be the region with the second highest TB incidence of about 2,901 in 2014 (NTP, 2014, unpublished data).

Accra Metropolitan Assembly (AMA) is divided into six sub metros namely Osu Klottey, Kpeshie, Okaikoi, Asheidu Keteke, Ablekuma and Ayawaso. The population peaks at age group 20- 24 (12.4% of the entire population) followed by age group 25-29 (11.5% of the

entire population). A greater proportion (89%) of the AMA population aged 11 years and older are literates (Ghana Statistical Service, 2014). Accra Metropolitan has 218 health facilities consisting of 28 hospitals, 130 health centers and 60 other forms of health post One hundred and eighty seven (187) of these health facilities are owned by private and non-governmental organizations. The main health problem of Accra metropolitan is infectious disease especially malaria and cholera due to poor sanitation and poverty (Ghana Statistical Service, 2014).

The Greater Accra Regional Hospital was formally known as Ridge Regional Hospital with about 191-bed capacity. After the current renovation, the facility was equipped to a 600-bed capacity. The Greater Accra Regional Hospital is one of four government hospitals in the metropolis and provides medical care ranging from general medicine to specialized medical care. The total medical staff strength of the facility is about 736. The hospital has a separate laboratory for TB testing with an average monthly acid fast bacilli request of 79. The facility also has a DOT center responsible for dispensing TB drugs, monitoring and recording treatment progress of TB patients. Some staff at the DOT center are recruited and trained by the National Tuberculosis Program (NTP) in Ghana.

Figure 3.2: Map showing the location of the Greater Accra Regional Hospital

3.3 Study Population

The study population included all Health Care Workers (HCWs) directly involved in TB care and others involved in out-patient management at the Greater Accra Regional Hospital. This included medical staff of the following units: DOTS, ART, Medical, Surgical, Dental, OPD and Triage, Paediatrics (Child Health), Pharmacy, Physiotherapy,

Radiography, Diet Therapy, Nutrition, ENT, Eye, Laboratory and ANC. A survey at the units of interest indicated a total of 201 Health Care Workers who were at post at the time of the study.

3.3.1 Inclusion Criteria

- Health Care Workers who were willing and consented to participate in the study.

3.3.2 Exclusion Criteria

- Health Care Workers unwilling to consent were excluded from the study.
- Health Care Workers who were on any form of leave were also excluded.

3.4 Study Variables

Dependent variable: Tuberculosis Infection Control

Table 3.1: List of Independent Variables

Variables	Definition	Scale of Measurement
Age	Age at last birthday in years	Discrete
Gender	Male or Female	Categorical
Job Category	Professional category of HCWs	Categorical
Educational Status	No education, Primary, secondary, tertiary	Categorical
Marital Status	Single, Married, Separated/Divorced, Widowed	Categorical
Professional years	No. of years spent working in area of specialization	Continuous
Number of years at facility	Number of years spent working in this facility	Continuous
Existing medical condition (s)	Any record of existing medical condition (s) If yes, please state	Categorical
Availability of TBIC materials	Presence of written TBIC plan or policy Availability of PPEs Availability of IEC materials to inform, educate and remind staff and patients on TBIC	Categorical
Triaging	Prompt identification of patients with TB symptoms	Categorical

Screening of TB suspects	Are cough patients (TB suspects) screened for TB	Categorical
Isolation of TB patients	Are suspected or diagnosed TB patients isolated from other clinic attendees?	Categorical
Availability of TB laboratory for testing and reporting	Presence of separate laboratory for TB testing and reporting	Categorical
Education on cough etiquette	Instruct patients with chronic cough on cough hygiene	Categorical
	Covering nose and mouth when coughing or sneezing	
Training of staff on TBIC	Were you trained on TBIC	Categorical
	How many years ago?	Continuous
Screening of HCWs	Are HCWs periodically screened for TB?	Categorical
TB prevention and care interventions for HCWs	Is there a prevention and care intervention for HCWs with TB	Categorical
Supervision and coordination	Existence of a focal person to monitor effective implementation of TBIC	Categorical
	Existence of a focal person who coordinates with National TB Programme.	
	Existence of Infection Control committee	
Availability of adequate ventilation	Availability of functional natural or mechanical ventilation system	Categorical

	Windows	
	Fans	
	Wind-driven air extractor turbines	
	(whirlybirds) installed in indoor waiting areas	
	Ultraviolet germicidal irradiation)	
	Windows positioned on opposite sides of walls of wards or rooms	
	Are windows opened daily	
	Are outdoor waiting areas large enough to seat patients without crowding?	
Safe sputum disposal methods	Availability of well-ventilated sputum booths at vantage points (outdoors in the facility)	Categorical
	Sputum samples collected from booths	
Personal protection measures	Use of N95 respirators by HCWs	

3.5 Sampling and Sampling Procedure

3.5.1 Sample Size Determination

The sample size calculation for the HCWs was based on a total population of medical staff of 201 who were at post within the study period from the following units; DOTS, ART, Medical, Surgical, OPD and Triage, ENT, Pharmacy, Radiography, Laboratory and Dental. Therefore using the sample size formula by Yamane 1967,

$$n_o = \frac{N}{1 + N(e)^2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where:

n: sample size

N: the population size of the HCWs, 201

e: precision, 5% (0.05)

Inputting the above into equation (1), the minimum sample size of Health Care Workers required for this study was given by:

$$n_o = \frac{201}{1+201(0.05)^2} = 133.8 \approx 134$$

Therefore, the minimum sample size for Health Care Workers was 134.

3.5.2 Sampling Procedure

A complete survey was done to obtain the number and cadre of Health Care Workers (HCWs) in the various units of interest. The units: DOTS Center, ART, Medical, OPD, Triage, Paediatrics and Pharmacy, were selected using simple random sampling technique. Data collection started from 22nd May to 28th June, 2017. The proportion of Health Care

Workers selected from each category was based on the number of staff (n=201) present at the various units within the study period: nurses (n=73), Doctors (n=78), Pharmacists (n=15) and Allied Health Professionals (n=35). The constant proportion of 0.667 [134/201= 0.667] was multiplied by the number of persons in each job category to obtain the expected sample size for each category. Finally, the sample size for each category was used to obtain the percentage of persons that was selected. The Table below shows the sample size for each of the job categories in the study.

Table 3.2: HCWs Distribution from Each Job Category

Job Category	Total Number	Constant Proportion	Sample Size Required	Percent (%) from Each Group
Doctors	73	0.667	49	36.57
Nurses	78	0.667	52	38.81
Pharmacy Personnel	15	0.667	10	7.45
Allied Health Professionals	35	0.667	23	17.16
Total	**201**		**134**	**100**

The sample size (134) was apportioned to each selected unit based on the size of health care workers at post during the period of data collection. Stratification of the HCWs was done according to their job category. The sampling frame (list of health care workers by job category) for each stratum was obtained from the units and a simple random sampling method applied to recruit them. The random numbers were computer generated using

Microsoft Excel. The aim was to ensure that every Health Care Worker had an equal chance of being selected.

3.5.3 Data Collection Instruments

The Health Care Workers (HCWs) were made to read and sign the consent forms (Appendix I) given to them before they were administered the questionnaire (Appendix II). Concerns and questions regarding the study were also addressed. A semi-structured questionnaire adapted from Codjoe (2012) was modified according to the WHO guideline for reducing TB transmission in healthcare settings (WHO, 2009). The questionnaire was in four (4) sections. Section one (1) covered the socio-demographic information and work-related demographics of the HCWs (age, gender, marital status, educational status, job category, professional working years, years worked in facility, current unit of work, training on TBIC and presence of any known medical condition). Section two (2) assessed the level of knowledge and practices of the Health Care Workers on TB and TB Infection Control (Mode of TB spread, classical signs/symptoms of TB, Persons with high risk of TB exposure and infection, cough etiquette, persons with greatest risk of TB spread in healthcare settings, use of PPEs, ways of identifying TB suspects etc). Section three (3) explored service factors influencing TBIC at the facility (availability of TBIC materials, availability of separate laboratory for TB testing and reporting, screening of TB patients and Staff, isolation of infectious patients and availability of intervention packages for HCWs). Section four (4) examined the environmental factors influencing TB infection control (size of waiting area, crowding, ventilation and availability of well-ventilated sputum booth). The questions on knowledge and practice were assessed using 10 and 11 responses respectively. "Yes" or "No" were scored as "1" and "0" respectively. Knowledge

or Practice scores above the mean score were considered as "good" while those below the mean were considered "poor" (Demissie Gizaw et al., 2015).

3.5.4 Key Informant Interviews

Purposive sampling using maximum variation technique was employed to recruit seven (7) key individuals responsible for effective implementation of TBIC at the Greater Accra Regional Hospital. Purposive sampling technique is "used in qualitative research for the identification and selection of information rich cases related to the phenomenon of interest" (Palinkas et al., 2015). Seven (7) key informants comprising of the Medical Director, Hospital Administrator, Accountant, Greater Accra Regional Physician in charge of TB care, Infection Prevention Control (IPC) focal person, DOTS Center In-charge and Head of TB Bacteriology Laboratory were purposively selected. A Key Informant Interview (KII) guide adopted from Adeleke (2012), and modified in accordance with the WHO Tuberculosis Infection Control guideline was used for the interviews. The information obtained was used to triangulate information provided by the HCWs and direct observation. The Key Informants Interviews (KIIs) lasted between 10-60 minutes and recorded using an audio recorder. Notes were also taken to ensure accuracy. The KIIs were carried out at the offices of the participants to ensure privacy.

3.5.5 Direct Observation of Health Care Workers' Practice

Health care workers were observed directly during their routine work to assess how they carried out TB infection control. An observation grid outlining observable measures of administrative, environment and personal protection was used. The researcher spent five (5) working days observing daily TBIC practices. This approach informed on additional questions to include in semi-structured interviews and complemented the results thereof.

3.6 Quality Control

3.6.1 Data Handling

- Data collection tools were pre-tested at the University of Ghana Hospital prior to data collection.
- Research Assistants were trained to accurately carry out the data collection.
- The study materials were well explained to the HCWs prior to interview.
- Questionnaires and field notes were cross-checked by principal researcher.

3.6.2 Data Storage / Data Protection

All the questionnaires, checklists and transcripts were kept under lock and key in a cabinet. A soft copy of data collected were coded and locked on a computer using a password and only accessible to the principal researcher and others involved in the research work.

3.6.3 Data Validation

Research assistants were trained on appropriate data collection skills to ensure uniformity of data collected. Data collected daily on the field were checked and cleaned manually for completeness, clarity and consistency.

3.6.4 Pre-testing of Tools

The data collection tools were pre-tested at the University of Ghana Hospital using 20 participants before the commencement of the study. The pre-testing helped to clarify the data collection tools and to ensure research adequacy and freedom from bias. It also unearthed ambiguity in the questions thereby enabling rephrasing of such questions, and ensured a logical flow of the items on the questionnaire. Further, it enabled the research team to have a better appreciation of the data collection process.

3.7 Data Analysis

Quantitative data collected were entered into REDcap and Excel and then transferred into STATA 14.0 for cleaning, merging and analysis. Data were cleaned by running the frequencies of the variables to check for any form of inconsistencies. The inconsistent data were then checked with the raw data from the questionnaire. Knowledge and practice scores were computed for all correct responses to the questions. There were 10 responses for assessing level of knowledge and 11 responses for assessing HCWs practice on TBIC. Scores equal to or above the mean (7.8 for knowledge level, and 5.9 for practice level) were termed "good" while those below the mean were considered "poor." Data were presented using frequency tables and charts where necessary. Mean and standard deviations were computed for continuous variables and proportions for categorical variables. Chi-square was used to determine the association between level of knowledge and practice, and demographic characteristics and Fisher's exact test was used when sample size was small. Cramers V was used to determine the strength of the association between level of knowledge and practice and demographic characteristics. Logistic regression was then used to determine the Odds Ratio for the independent variables, which were statistically significant. Significance was set at $p<0.05$.

Qualitative data was analyzed manually. Thematic content analysis was used to analyze the transcribed data from key informant interviews and non-participant observation. Transcripts were read several times to get an overall picture of the contents and meaningful ideas coded, condensed and categorized into broader themes (Graneheim & Lundman, 2004), such as availability of TBIC materials, adequacy of ventilation at the facility, training of HCWs on TBIC, screening of HCWs and patients. Data were then interpreted

using insights, intuition and literature and presented in texts, verbal quotation. The qualitative finding were used to triangulate the information received from the HCWs and the direct observation.

3.8 Limitations

1. At the time of the study, the hospital was in a state of transition from its old building into a newly built ultra-modern facility. As such, responses were mixed reflecting the situation of both the old and new structures and facilities of the hospital.
2. The study explored educational status of the Health Care Workers based on primary, secondary and tertiary educational level which resulted a skewed response toward tertiary education. As such, no variation was found during data analysis, leading to the exclusion of educational status from the logistic regression model.
3. The use of a cross-sectional study. Cross sectional study design is a snapshot and responses can vary if measured at different times.

3.9 Ethical Issues

This study obtained ethical clearance from Ghana Health Service Ethical Review Committee (GHS-ERC). A written informed consent was obtained from the participants before they were recruited in the study. Permission was also sought from the head of the Greater Accra Regional Hospital before the study commenced.

3.9.1 Privacy and Confidentiality

Interviews were done in a manner to ensure privacy and confidentiality. Each participant was assigned a code to avoid using names and ensure anonymity. The information collected from the interviews was treated confidential and available only to the researcher and other

custodians of the research. Hard copy of questionnaires was kept under lock and key in a box while soft copy of data was password protected on a laptop. The data will then be destroyed after five years.

3.9.2 Voluntary Participation and Withdrawal

The objectives and procedures of the study were well explained to the participants and they were made aware that they were free to participate or withdraw from the research any time without any negative effect.

3.9.3 Benefits

There was no direct monetary benefit in this study. However, participants were given souvenirs and also got the opportunity to add on to knowledge in the area of TB infection control and its effective implementation for societal benefit.

3.9.4 Cost/Compensation

Participants did not incur any cost in this study. The study did not also provide compensation in the form of money to the participants.

3.9.5 Declaration of Conflict of Interest

The researcher had no potential conflict of interest with respect to the study.

3.9.6 Research Funding

This research was funded by the NIH Fogarty International Centre through partnership with the University of Ghana, College of Health Sciences and the University of Florida.

CHAPTER FOUR

RESULTS

4.0 Introduction

This chapter details the findings of this study in line with the set objectives. It is in four sections. Section one shows socio-demographic and work-related characteristics of participants. Section two presents the knowledge and practice of Health Care Workers on TB and TB Infection Control. Sections three and four present the service and environmental factors influencing the implementation of TB infection control (TBIC).

4.1 Socio-Demographic Characteristics of Participants

A total number of 137 Health Care Workers (HCWs) participated in the study. Majority, 62 (45.3%) of the Health Care Workers were between the ages 18 to 29 years, and the mean age was 32.5 years (SD = 7.6). Almost two-thirds, 85 (62.0%) of the participants were females, and more than half, 76 (55.5%) were married (Table 4.1a). In terms of educational status, almost all, 136 (99.3%) of the participants had tertiary education. Also, 123 (89.8%) of the participants indicated that they had no medical condition, and none of the medical conditions indicated was tuberculosis.

Table 4.1a: Socio-Demographic Characteristics of Health Care Workers (HCWs)

Characteristics	Number (n=137)	Percent (%)
Age (years)*		
18 to 29 years	62	45.3
30 to 39 years	56	40.9
40 to 49 years	9	6.6
50 years and above	10	7.3
Gender		
Male	52	38.0
Female	85	62.0
Marital Status		
Single	60	43.8
Married	76	55.5
Separated/Divorced	1	0.7
Educational Status		
Secondary	1	0.7
Tertiary	136	99.3
Presence of medical condition		
No	123	89.8
Yes	14	10.2
Medical condition**		
Allergic Rhinitis	2	16.7
Asthma	2	16.7
Back pain	2	16.7
Coccyx pain	1	8.3
Hypertension	4	33.3
Polycystic Ovarian Syndrome (PCOS)	1	8.3

*Mean Age of HCWs = (32.5 ± 7.6) years, Min. Age = 23 and Max. Age is 59

**Total number of HCWs with medical condition = 14. However, two participants did not indicate the medical condition.

A similar proportion of the participants were doctors, 50 (36.5%) or nurses, 52 (38.0%), and 25 (18.3%) being Allied Health professionals. More than half, 70 (51.1%) of them had a total professional working years of less than five years. Additionally, 87 (63.5%) had worked in the study facility between one and five years. Further, 30 (21.9%) of the participants were from the medical unit. The DOTS and ART units which were directly involved in TB care had nine participants in this study (Table 4.1b).

More than one-third, 53 (38.7%) of the participants reported that they had received some form of training on TB infection control in the facility. Of these, 29 (54.7%) were trained within the past year while 24 (45.3%) were trained over a year ago (Table 4.1b).

Table 4.1b: Work-related Demographics of Health Care Workers

Characteristics	Number (n)	Percent (%)
Job category		
Doctor	50	36.5
Nurse	52	38.0
Pharmacist	10	7.3
Allied Health Professionals***	25	18.3
Professional working years		
Less than 5 years	70	51.1
>=5 to <10 years	42	30.7
>=10 to <15 years	13	9.5
>=15 to <20 years	4	2.9
20 years and above	8	5.8
Years worked in facility		
Less than 1 year	7	5.1
>=1 to <5 years	87	63.5
>=5 to <10 years	33	24.1
>=10 to <15 years	5	3.7
>=15 to <20 years	2	1.5
20 years and above	3	2.2
Received Training on TBIC		
Yes	53	38.7
No	84	61.3
Period of last training received		
Less than or equal to one year ago	29	54.7
Over a year ago	24	45.3
Current Unit		
DOTS and ART	9	6.6
Laboratory	10	7.3
OPD	6	4.4
Medical	30	21.9
Surgical	11	8.0
Dental	16	11.7
Pharmacy	10	7.3
Paediatrics	25	18.3
Other****	20	14.6

OPD = Out Patient Department || ART = Antiretroviral Therapy || DOTS = Directly Observed Treatment, Short-Course center

***Midwife, Dietician, Dentist, Lab Personnel, Radiographer, Physiotherapy Personnel, Health Aide, Dental Technical Officer

**** ANC, ENT, Eye, Public Health, Treatment Room, Physiotherapy, Diet Therapy, Radiography

The age of the participants in the key informant interviews ranged from 34 to 58 years with a mean age of 44.7 years. More than two-thirds, 5 (71.4%) of the participants had their Master's Degree. The number of years the participants had worked in the facility ranged from 2 to 18 years with a mean of 7.8 years working experience and these were mainly managers of the units.

4.2 Level of Knowledge of HCWs on TB and TBIC

The overall level of knowledge was good in this study (Table 4.2), with 88 (64.2%) of the participants scoring equal or above the mean (7.8 ± 1.5).

Almost all, 131 (95.6%) of the participants correctly identified "airborne" as the mode of TB spread, and 124 (90.5%) recognized people who are immune-compromised such as HIV/AIDS patients as individuals with high risk of TB exposure and infection.

Table 4.2: Knowledge of Health Care Workers on TB and TBIC

Characteristics		Number (n)	Percent (%)
Mode of TB spread			
Airborne		131	95.6
Through blood or physical contact		6	4.4
Persons with higher risk of TB exposure and infection			
Persons who are Immuno-compromised, HIV/AIDS patients	Yes	124	90.5
	No	13	9.5
Symptom Identification			
Coughing out blood	Yes	114	83.2
	No	23	16.8
Weight Loss	Yes	120	87.6
	No	17	12.4
Night Sweats	Yes	112	81.8
	No	25	18.3
Fever	Yes	36	26.3
	No	101	73.7
Persons with greatest risk for TB spread in Healthcare setting			
Undiagnosed coughing patients		97	70.8
HCWs who do not use respirators when attending to TB patients		35	25.6
Don't know		5	3.7
Cough etiquette			
Covering mouth with tissue or upper arm during cough or sneezing	Yes	128	93.4
	No	9	6.6
Cough etiquette is required of all persons at all times	Yes	86	62.8
	No	51	37.2
Best and cheapest way to reduce TB bacilli in the air			
Use of natural ventilation (doors, windows) and maximizing cross-ventilation)		120	87.6
Other (mechanical ventilation, use of respirators, hand hygiene)		17	12.4
Overall Knowledge Level			
Poor knowledge		49	35.8
Good Knowledge		88	64.2

TB=Tuberculosis HIV/AIDS= Human Immune Virus/Acquired Immune Deficiency Syndrome

Concerning signs and symptoms of TB patients, 120 (87.6%) of the participants mentioned weight loss as a classical sign while only 36 (26.4%) identified fever as a classical sign of TB. More than two-thirds, 97 (70.8%) identified undiagnosed coughing patients as potential risk groups for TB spread in Healthcare settings. For cough etiquette, 86 (62.8%) admitted that cough etiquette is required of all persons at all times. Additionally, 120 (87.6%) of the HCWs recognized the use of natural ventilation (doors, windows) and maximizing cross-ventilation as the best and cheapest way to reduce TB bacilli in the air (Table 4.2).

4.3 Relationship between Level of Knowledge and Demographic Characteristics of HCWs

Table 4.3 shows the relationship between level of knowledge and demographic characteristics of the HCWs. Gender, marital status and current unit of work were the variables that exhibited a statistically significant relationship with level of knowledge. Majority, 60 (70.6%) of the females had good knowledge relative to 28 (53.9%) of the males with good knowledge ($V = 0.17$, $p = 0.047$). A significantly higher proportion of the HCWs who were married, 55 (72.4%) recorded high level of good knowledge compared with the HCWs who were single, 32 (53.3%), [$V = 0.21$, $p = 0.036$]. The unit in which a health worker worked in the hospital determined the level of knowledge. Thus, it was not surprising that all of the HCWs directly involved in TB care (DOTS and ART) recorded "good knowledge" of TB and TBIC, while 8 (80.0%) of the Pharmacy and 23 (76.7%) of the Medical unit HCWs also displayed good knowledge. However, majority, 7 (70.0%) of the laboratory HCWs and 9 (56.3%) of the dental unit HCWs recorded poor knowledge.

The difference in knowledge of TB and TBIC by unit was statistically significant (V=0.36, p=0.018).

Age, educational status, job category, professional working years, years worked in the facility and training received on TBIC did not show any significant statistical relationship with knowledge of TB and TBIC. All adults between 40 to 49 years had good knowledge. Further, 39 (62.9%) of HCWs aged 18 to 29 years, and 35 (62.5%) of HCWs aged 30 to 39 years also had good knowledge (Table 4.3).

Table 4.3: Relationship between Level of Knowledge and Demographic Characteristics of HCWs

		Knowledge level			
Characteristics	Category	Good Knowledge	Poor Knowledge	Cramers V	P-Value
Gender	Male	28 (53.9)	24 (46.2)	0.170	0.047*
	Female	60 (70.6)	25 (29.4)		
Age Category	18 to 29 years	39 (62.9)	23 (37.1)	0.210	0.082
	30 to 39 years	35 (62.5)	21 (37.5)		
	40 to 49 years	9 (100.0)	0 (0.0)		
	50 years and above	5 (50.0)	5 (50.0)		
Marital Status	Single	32 (53.3)	28 (46.7)	0.207	0.036*
	Married	55 (72.4)	21 (27.6)		
	Separated/Divorced	1 (100.0)	0 (0.0)		
Educational Status	Secondary	1 (100.0)	0 (0.0)	-0.064	0.642
	Tertiary	87 (64.0)	49 (36.1)		
Job Category	Nurse	31 (59.6)	21 (40.4)	0.181	0.217
	Doctor	36 (72.0)	14 (28.0)		
	Pharmacist	8 (80.0)	2 (20.0)		
	Allied Health Professional	13 (52.0)	12 (48.0)		
Professional Working Years	Less than 5 years	47 (67.1)	23 (32.9)	0.194	0.267
	>=5 to <10 years	23 (54.8)	19 (45.2)		
	>=10 to <15 years	11 (84.6)	2 (15.4)		
	>=15 to <20 years	3 (75.0)	1 (25.0)		
	20 years and above	4 (50.0)	4 (50.0)		
Facility Working Years	Less than 1 year	4 (57.1)	3 (42.9)	0.152	0.760
	>=1 to <5 years	55 (63.2)	32 (36.8)		
	>=5 to < 10 years	22 (66.7)	11 (33.3)		
	>=10 to <15 years	4 (80.0)	1 (20.0)		
	>=15 to <20 years	2 (100.0)	0 (0.0)		
	20 years and above	1 (33.3)	2 (66.7)		
Current Unit of Work	DOTS and ART	9 (100.0)	0 (0.0)	0.360	0.018*
	Medical	23 (76.7)	7 (23.3)		
	Surgical	8 (72.7)	3 (27.3)		
	OPD & Triage	3 (50.0)	3 (50.0)		
	Pharmacy	8 (80.0)	2 (20.0)		
	Dental	7 (43.8)	9 (56.3)		
	Paediatrics	16 (64.0)	9 (36.0)		
	Laboratory	3 (30.0)	7 (70.0)		
	Other	11 (55.0)	9 (45.0)		
Received Training on TBIC	Yes	3 (64.2)	30 (35.7)	0.0014	0.987
	No	54 (64.3)	19 (35.9)		

* Significant at p<0.05

Generally, the majority of all job categories had good knowledge scores, with Pharmacist (80.0%) and Doctors (72.0%) recording the highest. Likewise, the majority of all categories for professional working years and years worked in the facility of study had good knowledge scores (Table 4.3). In terms of training on TBIC, there was no significant variation of the knowledge level between the participants who have received training (64.2% good knowledge level), and those who have not received training (64.3% good knowledge).

4.4 Health Care Worker Factors Associated with Level of TB and TBIC Knowledge

From Table 4.4, females had 2.06 times the odds of good knowledge compared to the males and this was significant (95% CI 1.00-4.22). The odds of the good knowledge increased to 2.80 after adjusting for age, marital status, job category, current unit of work, years worked in facility and training on TBIC (95% CI 0.98-7.97). The Health Care Workers between the ages of 30 to 39 years had 2% reduced odds of good knowledge compared to those who were aged 18 to 29 years (95% CI 0.47-2.07). The participants who were married were 2.29 times more likely to have good knowledge compared to those who were single (95% CI 1.12-4.68). However, multivariate logistic regression models that included variables for gender, age, job category, current unit of work, years worked in facility and training on TBIC revealed that marital status is the strongest determinant of knowledge, AOR 3.19 and 95% CI (1.11-9.13).

Table 4.4: Odds Ratio of Socio-demographic and Work-related Factors Associated with Level of Knowledge of Health Care Workers on TB and TBIC

Characteristics	Category	COR (95% CI)	AOR (95% CI)
Gender			
	Male	Ref	Ref
	Female	2.06 (1.00-4.22)*	2.80 (0.98-7.97)
Age Category			
	18 to 29 years	Ref	Ref
	30 to 39 years	0.98 (0.47-2.07)	0.98 (0.30-3.17)
	40 to 49 years	1	1
	50 years and above	0.59 (0.15-2.26)	0.39 (0.04-4.09)
Marital Status			
	Single	Ref	Ref
	Married	2.29 (1.12-4.68)*	3.19 (1.11-9.13)*
	Separated/Divorced	1	1
Job Category			
	Nurse	Ref	Ref
	Doctor	1.74 (0.76-3.99)	2.98 (0.78-11.43)
	Pharmacist	2.71 (0.52-14.05)	0.92 (0.08-10.75)
	Allied Health Professional	0.73 (0.28-1.92)	1.39 (0.20-9.80)
Current Unit			
	DOTS and ART	Ref	Ref
	Medical	2.69 (0.79-9.12)	1.61 (0.27-9.55)
	Surgical	2.18 (0.44-10.73)	1.04 (0.10-11.02)
	OPD & Triage	0.82 (0.13-5.08)	0.56 (0.06-5.50)
	Pharmacy	3.27 (0.55-19.45)	1
	Dental	0.64 (0.17-2.39)	0.32 (0.06-1.88)
	Paediatrics	1.45 (0.44-4.84)	0.62 (0.11-3.66)
	Laboratory	0.35 (0.07-1.76)	0.27 (0.03-2.15)
	Other	1	1
Years worked in facility			
	Less than 1 year	Ref	Ref
	>= 1 to <5 years	1.29 (0.27-6.13)	1.84 (0.26-12.84)
	>= 5 to <10 years	1.50 (0.28-7.91)	1.79 (0.19-17.31)
	>=10 to <15 years	3.00 (0.21-42.62)	1.82 (0.07-46.88)
	>=15 to <20 years	1	1
	20 years and above	0.38 (0.02-6.35)	1.39 (0.03-66.74)
Received Training on TBIC			
	No	Ref	Ref
	Yes	0.99 (0.49-2.04)	0.54 (0.21-1.43)

*Significant association, p<0.05 COR=Crude Odds Ratio AOR=Adjusted Odds Ratio

Participants who were doctors had an increased odds of good knowledge compared to nurses [COR=1.74, 95% CI (0.76-3.99)]. After adjusting for gender, age, marital status, current unit of work, years worked in facility and training on TBIC, the odds of good knowledge increased to 2.98 (95% CI 0.78-11.43). Pharmacists also recorded 2.71 times the odds of good knowledge compared to the nurses (95% CI 0.52-14.05). However, the odds of good knowledge reduced by 8% after adjusting for the other variables (95% CI 0.08-10.75).

The Health Care Workers at the medical and surgical unit had increased odds of good knowledge [COR= 2.69 (95% CI 0.79-9.12)] and [COR= 2.18 (95% CI 0.44-10.73)] respectively although not significant (p>0.05). On the other hand, AOR were 1.61 (95% CI 0.27-9.55) and 1.04 (95% CI 0.10-11.02) respectively in the multivariate models. Years worked in facility and training on TBIC did not show any significant association with TBIC knowledge (Table 4.4). One of the KIIs indicated that,

> *"...One sad thing is that, when we even organize the workshop for them, the training, they will register, and they will not sit to enjoy the learning and teaching process that will go on. Few minutes, you will see them on their phone and they will walk out, and the presenter will also be presenting... So they don't actually benefit fully from the training programs that we organize in this facility..."* (KII-04, GARH).

4.5 Level of Practice of Health Care Workers (HCWs) of TB Infection Control

From Table 4.5, the overall level of practice of the Health Care Workers was good, with 83 (60.6%) scoring equal to or above the mean (5.9 ± 1.5). The minimum score was 2 while

the maximum score 9. Most, 119 (86.9%) of the HCWs mentioned that they use chronic cough for > 2 weeks as a means of identifying TB suspects. However, only 17 (12.4%) use presence of fever to identify the suspects.

Majority, 125 (91.2%) of health workers interviewed reported that they screened people suspected of TB while 100 (73.0%) of them separated TB patients from other patients. Fast tracking of smear positive cases to minimize stay in hospital and education of patients on cough etiquette were minimally practiced by the HCWs. Thirty-seven (27.0%) of health workers practiced fast tracking of smear positive cases while 33 (24.1%) practiced education of patients on cough etiquette.

More than half, 73 (53.3%) of the health workers provided nose masks to coughing patients while 113 (82.5%) of them reported that they use personal protective equipment when working with high risk individuals (Table 4.5).

Table 4.5: Practice of HCWs regarding TB Infection Control at the Greater Accra Regional Hospital

Characteristics		Number (n=137)	Percent (%)
Promptly Identify TB suspects using signs/symptoms			
Chronic cough > 2 weeks	Yes	119	86.9
	No	18	13.1
Coughing out blood	Yes	46	33.6
	No	91	66.4
Weight Loss	Yes	81	59.1
	No	56	40.9
Night Sweats	Yes	53	38.7
	No	84	61.3
Fever	Yes	17	12.4
	No	120	87.6
Screening of suspected TB patients			
Screen TB suspects		125	91.2
Do not screen TB suspects		12	8.8
Separation of TB Patients			
Separate TB patients		100	73.0
Do not separate TB patients		37	27.0
Fast track smear positive cases to minimize stay in facility			
Yes		37	27.0
No		100	73.0
Educate coughing patients on cough etiquette			
Yes		33	24.1
No		104	75.9
Provide nose mask or tissue to coughing patients			
Yes		73	53.3
No		64	46.7
Use of Personal Protective Equipment			
Yes		113	82.5
No		24	17.5
Overall Practice Level			
Good Practice		83	60.6
Poor Practice		54	39.4

4.6 Relationship between Level of Practice and Demographic characteristics of Health Care Workers

Tables 4.6a and 4.6b present the relationship between the level of practice of the HCWs on TBIC and their demographic characteristics.

Job category, professional working years, current unit of work and level of knowledge were significantly associated with the level of practice of HCWs in implementing TBIC. Majority, 42 (84.0%) of the doctors exhibited good practice while 8 (32.0%) of the Allied Health Professionals recorded good practice (V= 0.40, p<0.001). With reference to professional working years, most, 7 (87.5%) of the HCWs who had worked for 20 years and above had good practice while more than two thirds of the participants who had worked between 10 and 15 years had poor practice (V=0.32, p=0.005). A greater proportion of the staff from Medical unit, 26 (86.7%) and Surgical unit, 9 (81.8%) displayed good practice. On the contrary, majority, 8 (80.0%) of the staff from the Laboratory and 12 (75.0%) of the staff from Dental unit had poor practice (V= 0.47, p<0.001). In terms of level of knowledge, a greater proportion, 64/88 (72.7%) of those with good knowledge had good practice (V= 0.33, p<0.001).

Gender, age category, marital status, years worked in the facility, receiving training on TBIC and presence of a known medical condition were not statistically significant with the level of practice of the Health Care Workers. Thirty-four (65.4%) of the male HCWs had good TBIC practice compared to the females. Majority, 7 (70.0%) of the participants aged 50 years and above exhibited good practice while 41 (66.1%) of those aged 18 to 29 years recorded good level of practice. Almost, equal proportion of health workers who were single 36 (60.0%) and married 46 (60.5%) had good practice. In terms of years worked in

the facility, all of the participants who had worked in the facility between 15 years and 20 years had good TBIC practice while 5 (71.4%) of those who had worked for less than a year displayed good level of practice.

A greater proportion, 10/14 (71.4%) of the Health Care Workers who indicated that they had known medical condition(s) had good TBIC practice (Table 4.6a and Table 4.6b). There was almost no difference in the level of TBIC practice among the HCWs who had received training on TBIC, 32 (60.4%) and to those who had not, 51 (60.7%).

Table 4.6a: Relationship between Level of Practice and Socio-demographic Characteristics of HCWs

		Level of Practice			
Characteristics	**Category**	**Good Practice**	**Poor Practice**	**Cramers V**	**P-value**
Gender	Male	34 (65.4)	18 (34.6)	-0.077	0.368
	Female	49 (57.7)	36 (42.4)		
Age Category	18 to 29 years	41 (66.1)	21 (33.9)	0.133	0.486
	30 to 39 years	30 (53.6)	26 (46.4)		
	40 to 49 years	5 (55.6)	4 (44.4)		
	50 years and above	7 (70.0)	3 (30.0)		
Marital Status	Single	36 (60.0)	24 (40.0)	0.069	1.000
	Married	46 (60.5)	30 (39.5)		
	Separated/Divorced	1 (100.0)	0 (0.0)		
Job Category	Nurse	27 (51.9)	25 (48.1)	0.398	<0.001*
	Doctor	42 (84.0)	8 (16.0)		
	Pharmacist	6 (60.0)	4 (40.0)		
	Allied Health Professional	8 (32.0)	17 (68.0)		
	Less than 5 years	50 (71.4)	20 (28.6)	0.318	0.005*
	>=5 to <10 years	20 (47.6)	22 (52.4)		
	>=10 to <15 years	4 (30.8)	9 (69.2)		
	>=15 to <20 years	2 (50.0)	2 (50.0)		
	20 years and above	7 (87.5)	1 (12.5)		
Facility Working Years	Less than 1 year	5 (71.4)	2 (28.6)	0.146	0.805
	>=1 to <5 years	54 (62.1)	33 (37.9)		
	>=5 to < 10 years	17 (51.5)	16 (48.5)		
	>=10 to <15 years	3 (60.0)	2 (40.0)		
	>=15 to <20 years	2 (100.0)	0 (0.0)		
	20 years and above	2 (66.7)	1 (33.3)		

*Significant at p<0.05

Table 4.6b: Relationship between Level of Practice and Socio-demographic Characteristics

		Level of Practice			
Characteristics	**Category**	**Good Practice**	**Poor Practice**	**Cramers V**	**P-value**
Current Unit of Work	DOTS and ART	4 (44.4)	5 (55.6)	0.466	<0.001*
	Medical	26 (86.7)	4 (13.3)		
	Surgical	9 (81.8)	2 (18.2)		
	OPD & Triage	2 (33.3)	4 (66.7)		
	Pharmacy	6 (60.0)	4 (40.0)		
	Dental	4 (25.0)	12 (75.0)		
	Paediatrics	16 (64.0)	9 (36.0)		
	Laboratory	2 (20.0)	8 (80.0)		
	Other	14 (17.0)	6 (30.0)		
	Yes	10 (71.4)	4 (28.6)	-0.075	0.283
	No	73 (59.4)	50 (40.7)		
	Yes	32 (60.4)	21 (39.6)	0.003	0.969
	No	51 (60.7)	33 (39.3)		
Level of Knowledge	Good Knowledge	64 (72.7)	24 (27.3)	0.333	<0.001*
	Poor Knowledge	19 (38.8)	30 (61.2)		

*p<0.05 is considered statistically significant

4.7 Work-related Factors Associated with Level of Practice of Health Care Workers on Tuberculosis Infection Control

The odds of good practice (Table 4.7) was 4.86 times (95% CI 1.92-12.34) higher among doctors compared to nurses. However, the odds increased to 7.91 (95% CI 1.73-36.18) after adjusting for current unit of work, professional working years, training received on TBIC and level of knowledge on TB and TBIC. Contrary, the odds of good practice was 56% (95% CI 0.16-1.19) less among the Allied Health Professionals compared to the nurses although not significant; adjusting for the other variables further reduced the odds of good TBIC practice to 82% (95% CI 0.02-1.35) less compared to the nurses.

There was significantly higher odds of good practice among HCWs at the Medical unit compared to the units directly involved in TB care (DOTS and ART unit), (COR=8.13 95% CI 1.51-43.78). The multivariate analysis showed an AOR of 2.60 (95% CI 0.28-24.22). Furthermore, the HCWs in other units (ENT, Eye, ANC, Diet Therapy, Radiography, and Physiotherapy) were 2.92 times (95% CI 0.57-14.82) more likely to exhibit good practice compared to those at DOTS and ART. After adjusting for job category, professional working years, received training on TBIC and level of knowledge, this odds of good TBIC practice significantly increased to 8.84 (95% CI 1.03-75.56) among the workers in other unit compared to DOTS and ART (Table 4.7).

The health care workers who had worked for 20 years or more were 2.80 times (95% CI 0.32-24.24) more likely to display good practice compared to those who had worked for less than five years, although not significant. Further, this odds of good TBIC practice increased to 15.51 (95% CI 0.88-272.70) after the multivariate analysis. On the other hand, those who had worked between 5 and 10 years, and 10 and 15 years had significantly reduced odds of TBIC practice [COR=0.36 95% CI 0.16-0.81); COR=0.18 95% CI 0.05-0.64)] respectively compared to those who had worked for less than five years (Table 4.7).

Training was not significantly associated with level of practice. The odds of good practice among those who had some form of training on TBIC was almost the same as those who had not been trained (COR= 0.99 95% CI 0.49-1.99). However, after adjusting for job category, current unit of work, professional working years and level of knowledge, the odds of good practice was 1.60 times (95% CI 0.54-4.75) higher among those who had been trained compared to those who had not been trained, although not significant (Table 4.7).

There is also a statistically significant relationship between level of knowledge and level of practice. The Health Care Workers with good knowledge were 4.21 times (95% CI 2.01-8.84) more likely to have had good practice compared to those with poor knowledge After adjusting for job category, current unit of work, professional working years and training on TBIC, the odds of good TBIC practice increased to 5.83 (95% CI 2.07-16.43) (Table 4.7).

Table 4.7: Odds Ratio of Socio-demographic and Work-related Factors Associated with Level of TBIC Practice

Characteristics	COR (95% CI)	AOR (95% CI)
Job Catgeory		
Nurse	Ref	Ref
Doctor	4.86 (1.92-12.34)*	7.91 (1.73-36.18)*
Pharmacist	1.39 (0.35-5.50)	2.26 (0.21-24.04)
Allied Health Professional	0.44 (0.16-1.19)	0.18 (0.02-1.35)
Current Unit		
DOTS and ART	Ref	Ref
Medical	8.13 (1.51-43.78)*	2.60 (0.28-24.22)
Surgical	5.63 (0.75-42.36)	0.62 (0.04-10.11)
OPD & Triage	0.63 (0.07-5.35)	0.30 (0.02-3.99)
Pharmacy	1.88 (0.30-11.63)	1
Dental	0.42 (0.07-2.36)	0.16 (0.01-1.79)
Paediatrics	2.22 (0.47-10.45)	0.75 (0.09-6.50)
Laboratory	0.31 (0.04-2.38)	1.51 (0.08-29.81)
Other	2.92 (0.57-14.82)	8.84 (1.03-75.56)*
Professional working years		
Less than 5 years	Ref	Ref
>= 5 to <10 years	0.36 (0.16-0.81)*	0.95 (0.26-3.39)
>= 10 to <15 years	0.18 (0.05-0.64)*	0.15 (0.02-1.10)
>=15 to <20 years	0.40 (0.05-3.04)	1.22 (0.07-21.45)
20 years and above	2.80 (0.32-24.24)	15.51 (0.88-272.70)
Received Training on TBIC		
No	Ref	Ref
Yes	0.99 (0.49-1.99)	1.60 (0.54-4.75)
Level of Knowledge		
Poor Knowledge	Ref	Ref
Good Knowledge	4.21 (2.01-8.84)*	5.83 (2.07-16.43)*

*Significant association at p<0.05 COR=Crude Odds Ratio AOR=Adjusted Odds Ratio

4.8 Service Factors Influencing Implementation of TBIC at the Greater Accra Regional Hospital

Table 4.8 explored the service factors influencing TB infection control at the Greater Accra Regional Hospital. Generally, the Health Care Workers perceived screening of patients, availability of separate TB laboratory and availability of personal protective equipment as the service factors promoting sustained implementation of TBIC at the Greater Accra Regional Hospital. However, inadequate TBIC materials, lack of an isolation ward and the absence of staff screening were perceived as factors inhibiting sustained implementation of TB infection Control in the facility.

Availability of TBIC policy at the health facility was reported by 67 (48.9%) of the participants. However, 56 (40.9%) of them did not know of the availability of such policy. Most of the participants in the Key Informant Interviews (KIIs) also indicated the absence of a TBIC policy in the facility:

> *"There is one for Infection, Prevention and Control. I think it was launched around 2013/2015, when the Ebola scare came. So IPC came all on the agenda, so there was a national policy...we don't have a separate one for TB. Because we are part of the Ghana Health Service facilities, we all join what the headquarters produces. So they produce the guidelines and all facilities are supposed to adhere to it."* (KII-03, GARH)

> *"No [we don't have a structured TBIC policy in the facility] we are using the National TB Control Programme policies; and the Ghana Health*

Service (GHS) has policies on management of infectious diseases. So those two are integrated in managing TB." (KII-07, GARH)

"For this facility, No, we are all using the national guideline. So that's what we use." (KII-04, GARH)

A copy of the National Infection Prevention Control Policy was sighted during the direct observation process.

With reference to the existence of a TBIC committee or focal person in charge of TB infection control, more than half, 93 (67.9%) of the HCWs specified that there was a TBIC committee or focal person in the facility (Table 4.8).

The KIIs also indicated the existence of a TBIC committee or focal person in the facility for sustained TB Infection control.

"Yes, we have [a TBIC committee or focal person]. We have our Quality Assurance Team ... there are other members who constitute the committee. I was part of it. It is not limited to only TB. It is for all other infections in the facility..." (KII-04, GARH).

"Rather, we have a permanent team headed by a TB focal person/coordinator, and we also have another coordinator for ART. The two work together because TB has a link with HIV, so the two collaborate. And they also work closely with our laboratory, because of the sputum tests, and some other aspects of TB necessary for confirmation from the sputum,

etc. So, these 3 units work together, with support from management." (KII-06, GARH).

The existence of staff TB screening mechanism for HCWs was reported as being absent by 105 (76.6%) of the participants as there was no system in place for periodic staff screening for TB. The participants in the KIIs on the other hand, held divergent views about staff screening for TB in the hospital:

"I am not sure if there is a programme to screen staff; we haven't budgeted for that, which I am aware of as of now." (KII-02, GARH)

"It is available but people do not patronize" (KII-03, GARH)

"... They [the staff] are not interested, yet we have told them. When I get the opportunity to speak at every fora that is held in the facility, I hit on it. I can say apart from my staff members, all the others don't come [for TB screening]. But for us working directly at TB unit, we do it twice every year. This year, I have done the first one; I am still waiting. I will do the second one. I have told my staff members; they will also do theirs." (KII-04, GARH)

"No, if they suspect that the symptoms you are manifesting, you are likely [to have TB], then they screen them. Last year I heard one of the staff contracted TB or something like that." (KII-07, GARH).

Concerning special interventions for HCWs who might be infected with TB on the job, 51 (37.2%) responded that there was no such special intervention. Further, more than half, 81

(59.1%) of the HCWs stated that they were not aware if the facility had any such intervention package for staff (Table 4.8). Responses from the KIIs also affirmed that there was no special intervention for HCWs who might be infected with TB while on the job:

> *"Not a special [intervention] as such, but we have made arrangements for every staff to be on insurance. Secondly, by a collective agreement, we are to meet 50% of costs that are not covered by the National Health Insurance Scheme. Beyond that, where there is a crucial need, management will exercise discretion to support that. Those are the arrangements we have in terms of staff health care packages."* (KII-02, GARH).

> *"I don't know there is a package [for staff infected with TB]; but I know we have enablers that support the TB programme."* (KII-6, GARH)

> *"... No. They don't give anything. It's always from the National. Even for that, like I said, with 'The Enabler' package, there was something for staff; now it has been withdrawn for some time now. What they are now looking at is support for MDR patients. For that, they have something for treatment administration. It goes to the staff who is actually involved in patients care."* (KII-04, GARH)

Regarding the availability of an isolation ward for separation of infectious TB patients, almost half, 66 (48.2%) of the HCWs indicated the absence of an isolation ward in the facility, while 30 (22.9%) stated that they know of any isolation ward in the facility. The KIIs also reported the absence of an isolation ward in the old health facility:

"The problem is that we don't have a functioning Isolation Ward currently; only the verandas are used. That is a minus, because they are supposed to be cared for in an isolation ward. Therefore, that is a something we don't have which we have to factor into our plans." (KII-01, GARH)

"... For our new facility... we have now separated TB cases from the new facility because the whole place is air-conditioned, even though there are some isolation wards in there. So we have separate wards for TB cases now." (KII-03, GARH)

Sixty-six (48.2%) of the participants reported that the hospital had a separate laboratory for TB testing and reporting while 38 (27.7%) indicated that they were not aware of a separate TB laboratory in the facility. Direct-observation also revealed the existence of a separate laboratory for TB testing and reporting.

Table 4.8: Service Factors Influencing Implementation of TBIC at the Greater Accra Regional Hospital

Service Factors	Number (n=137)	Percent (%)
Availability of TBIC Policy		
Presence of TBIC Policy	67	48.9
Absence of TBIC Policy	14	10.2
Don't know	56	40.9
Existence of a TBIC Committee or Focal Person		
Existence of a TBIC Committee	93	67.9
Absence of a TBIC Committee	5	3.7
Don't know	39	28.5
Screening of Staff for TB		
Presence of staff screening	29	21.2
Absence of staff screening	105	76.6
Don't know	3	2.2
Availability of Special Intervention for HCWs		
Special Intervention present	5	3.7
No special Intervention	51	37.2
Don't know	81	59.1
Availability of a Separate TB Lab		
Presence of a separate lab	66	48.2
No separated lab	33	24.1
Don't know	38	27.7
Availability of TB Isolation Ward		
Presence of an isolation ward	41	31.3
No isolation ward	66	48.2
Don't know	30	22.9

4.9 Environmental Factors Influencing TB Infection Control at the Greater Accra Regional Hospital

Table 4.9 explored the environmental factors influencing the implementation of TB infection Control in the facility. Generally, there was no environmental factor perceived as promoting sustained implementation of TBIC in the facility. However, the HCWs perceived small waiting area, poor ventilation and absence of a well-ventilated sputum booth for safe sputum production and disposal as inhibitors to sustained implementation of TBIC in the facility.

More than half, 77 (56.2%) of the participants indicated that the size of the patients waiting areas were too small to accommodate patients without crowding, while majority, 104 (75.9%) reported that they sometimes experience crowding at the waiting areas. Respondents in the KIIs had this to say:

> *"The space [waiting area] was not adequate, especially with the old place. Now, we can say that there has been an improvement. But with the current tight environment with a centralized air-conditioning, I am not sure it is good for TB infection control."*
>
> (KII-01, GARH)

> *"Taking the OPD setting for example, the place is overcrowded; there is no proper ventilation."* (KII-04, GARH)

> *"Our concern was the way the OPD down there was closed in. It is very tight and ventilation was not the best. That was and still is our problem...*

even the fans just circulate that same stale air, which you need to take out; so you need something to extract the stale air out." (KII-03, GARH)

Direct observation at some of the units showed presence of crowding at the patient waiting areas.

The predominant ventilation type reported by participants was mixed ventilation (use of both natural and mechanical ventilation). Responses from the KIIs indicated that the facility used either natural, mechanical or mixed ventilation:

"... We have windows; we open the windows. When dealing with TB, we do not use the fans; we use natural ventilation." (KII-06, GARH)

"For our new facility, it is mainly air-conditioned..." (KII-03, GARH)

Ninety-six percent of the participants who used natural ventilation reported that they "always" open the doors and windows during work hours (Table 4.9).

Table 4.9: Environmental Factors Influencing Implementation of TBIC at the Greater Accra Regional Hospital

Environmental Factors	Number (n=137)	Percent (%)
Availability of Well-Ventilated Sputum Booth		
Presence of a sputum booth	5	3.65
Absence of sputum booth	104	75.91
Don't know	28	20.44
Frequency of sputum collection *		
Daily	3	60.0
Don't know	2	40.0
Size of waiting area		
Large waiting area	39	28.47
Small waiting area	77	56.2
Don't know	21	15.33
Crowding in waiting areas		
Crowded	104	75.91
Not crowded	31	22.63
Don't know	2	1.46
Kind of Ventilation in facility		
Natural Ventilation	24	17.52
Mechanical Ventilation	46	33.58
Mixed Ventilation	67	48.91
Frequency of opening windows**		
All day	53	96.36
Till Mid-day	1	1.82
Rarely	1	1.82
Maintenance of Mechanical Ventilation Equipment***		
1 to 6 months	11	8.94
6 to 12 months	5	4.07
As per breakdown	57	46.34
Rarely (More than 1 year)	6	4.88
Don't know	44	35.77

* n=5 selected 'yes' for availability of well-ventilated sputum booth. However 2 HCWs did not give any response

** n=55 responded to frequency of opening windows

*** Only 123 HCWs responded to question

One hundred and four (75.9%) of the HCWs stated that there were no sputum booths in the hospital for safe sputum production and disposal. Some of the participants had this to say,

> *"Apart from the washrooms which everybody uses, I do not think we have something like that [well-ventilated sputum booth]."* (IDI-03, GARH)

> *"... We do not have a vantage point [sputum booth] where we ask the patients to go and produce the specimen. We just ask the patients to go to an open space and produce the specimen and come ..."* (IDI-06, GARH)

This was also confirmed through direct observation.

CHAPTER FIVE

DISCUSSION

5.0 Introduction

This study aimed at assessing the Implementation of Tuberculosis Infection Control Measures among Health Care Workers at the Greater Accra Regional Hospital, Ghana. This chapter presents an in depth discussion of the study findings in line with the following specific objectives: Level of knowledge and Practice of Health Care Workers on TB Infection Control; Service Factors Influencing Sustained Implementation of TB Infection Control and Environmental Factors Influencing Sustained Implementation of TB Infection Control.

5.1 Level of Knowledge of Health Care Workers (HCWs) on TB and TBIC

Overall, the HCWs exhibited good level of knowledge. The findings of this study are supported by the findings of Temesgen & Demissie, (2014) among health professionals in Northwest Ethiopia, where they reported that "majority of the respondents had good TBIC knowledge." However, the observed level of knowledge (64.2%) in this study was lower than the 74.4% reported by Temesgen and Colleague. This is congruent with finding from a survey in rural South Africa where more than 90% of health care professionals identified the classical TB symptoms other than fever, which was identified by 58.9% (Kanjee, Catterick, Moll, Amico, & Friedland, 2011). Similarly, the level of knowledge reported in this study is consistent with the finding of Buregyeya, Kasasa, et al., (2016) where 69% of the Health Care Workers studied were classified as having adequate knowledge. Also, the level of knowledge on TBIC was generally high among health care professionals in rural South Africa (Kanjee et al., 2011).

Although most health workers in this study rightly identified the classical symptoms of TB, mode of TB transmission, proper cough etiquettes, and persons with high risk of TB spread, a significant majority (73.7%) failed to identify fever as part of the symptoms, hence the relatively lower level of knowledge recorded. The overall knowledge level had a bearing on the level of practice since approximate equal level of practice was found.

In this study, only gender, marital status and current unit of work were found to have significant association with TBIC knowledge level. Knowledge was highest amongst females (70.6%) than males, the married (72.4%) compared to the single and divorced HCWs. Similarly, knowledge was higher (100%) among those working at the DOTS and ART units than those in the other units. This result is similar to a research conducted in North Eastern Nigeria on HCWs' knowledge, awareness and compliance with standard precautions, which reported that women had higher knowledge than men (Abdulraheem, Amodu, Saka, Bolarinwa, & Uthman, 2012). The high knowledge levels among the workers at the DOTS and ART units could be due to their direct daily involvement in TB care and education of patients and the public on TB and its control. On the other hand, only 30% of the staff at the laboratory had good knowledge on TB and TBIC, which may be due to their focus on working on specimen rather than interacting and/or educating patients and the public, which they perceived as the role of those directly involved with patient care.

On the other hand, educational status, job category, training, professional working years, and years worked in facility did not have any significant relationship with level of knowledge. This is contrary to the findings of Demissie Gizaw et al., (2015) where educational status was significantly associated with level of knowledge. The reason for the difference may be attributed to the different categories of educational status used for the

two studies; this study categorized it into primary, secondary, tertiary and other levels, while Demissie Gizaw and colleagues categorized educational status into diploma, first degree, and second degree and above.

Further, this study did not find any significant association between level of knowledge and training received on TB infection control. However, this contrasts the findings of Temesgen & Demissie, (2014) where training was statistically significant with level of TBIC knowledge. The probable reason in this study may be due to improper staff attitude towards training.

5.2 Level of Practice of HCWs on TB and TBIC

The overall level of practice of the HCWs was good with more than half (60.6%) of the HCWs having good TBIC practice. This is consistent with the report from Northwest Ethiopia where they recorded an overall level of practice of 63.3% (Temesgen & Demissie, 2014). However, the level of practice in this study was higher than what was recorded by Tamir et al., (2016) in the West Gojjam Zone, Ethiopia (38.0%) and by Demissie Gizaw et al., (2015) in Addis Ababa, Ethiopia (48.6%).

This study also highlights that 91.2% of the HCWs indicate that they screen suspects for TB in the facility. This is higher than the study done in Ethiopia, where 71.6% of the health workers reported that they undertake TB screening at their departments (Tamir et al., 2016), and a study in Uganda, where only 43% of health professionals claimed to screen suspects for TB (Buregyeya et al., 2013). The high level of screening in the facility of this study may mainly be due to the presence of task-shifting officers positioned at various units to pick-up any TB suspect for screening. It may also be influenced by the presence of a

committed TB Coordinator and team, as deduced from the direct observation and key informant interviews. Regarding the use of personal protective equipment (N95 respirators and surgical masks), 82.5% of them reported that they use PPEs when attending to high risk individuals. From the direct observation done in this study, N95 respirators were rarely used and were reserved for the management of suspected MDR cases. A study by Tamir and colleagues recorded low proportion of health professionals (23.5%) use of N-95 respirators at the health centers (Tamir et al., 2016). The discrepancies in the proportions may be explained by the high usage of surgical masks instead of the N95 respirators by the HCWs in this study. Kanjee and Colleagues (2011) reported that more than half (54.7%) of their respondents "always" used respirators when attending to TB case or suspects in rural South Africa (Kanjee et al., 2011).

On the contrary, fast tracking of smear positive cases to minimize patient stay in hospital was minimally practiced by the health care workers (27.01%), as was similarly observed in other studies (Brouwer et al., 2014; Temesgen & Demissie, 2014). In this study, patients were attended to on "first come, first served" basis. This inability to fast track patients may be due to high patient turnout and high workload on staff as observed through direct observation. In addition, only 24.1% of HCWs stated that they educate patients on cough etiquette and this is lower than 77.4% reported in South Africa (Kanjee et al., 2011), and 60% in Ethiopia (Tamir et al., 2016).

The findings of this study reveal further that job category, professional working years, current unit of work and level of knowledge were significantly associated with TBIC practice levels among HCWs ($p<0.05$). Similar finding were recorded by Tamir et al., (2016) where the working department of the health professionals as well as their knowledge

status influenced the level of TBIC practice. Tuberculosis Infection Control practices is highest among doctors (84.0%) in this study compared to the other professionals. Also, HCWs with professional working years of 20 and above have the highest level of good practice compared to other range of years. In terms of current unit of work, it was recorded that practice of TBIC measures is highest among workers of the medical unit (86.7%) than all other units, whereas less than half (44.4%) of the1 workers directly related with TB care – DOTS and ART units- have good practice. This is contrary to findings by Demissie Gizaw et al. (2015), where experience in TB clinic was a major predictor of practice.

Furthermore, a significant relationship was identified between HCWs' knowledge on TB and TBIC, and their practice irrespective of other factors. Majority (72.7%) of the participants with good knowledge had good level of TBIC practice. Those with good knowledge were 4.1 times more likely to exhibit good practice compared to those with poor knowledge. This supports the findings of Temesgen & Demissie (2014), where knowledge was a strong predictor of good TBIC practice.

The high proportion of HCWs at the medical unit with good practice may be because the medical unit is directly responsible for housing patients with TB and other infectious diseases within the facility.

On the contrary, gender, age, marital status, years worked in the facility, presence of a known medical condition, and training on TBIC are not significant with level of TBIC practice, unlike the findings of Demissie Gizaw and colleagues, where tuberculosis-related training was significantly associated with TBIC practice (Demissie Gizaw et al., 2015).

5.3 Service Factors Influencing Sustained Implementation of TBIC

Health Care Workers perceived screening of patients, availability of separate TB laboratory and availability of personal protective equipment as the service factors promoting sustained implementation of TBIC in this study. However, a study in Mozambique, assessing the challenges faced by health care workers showed that prioritization of patients with cough, use of respirators, cough hygiene, proper ventilation and education were perceived as the most important measures (Brouwer et al., 2014).

On the other hand, this study identified inadequate TBIC materials (policy, IEC materials PPEs etc), lack of an isolation ward and the absence of staff screening as service factors perceived by the HCWs to be inhibiting sustained implementation of TB infection Control in the facility.

Participants (48.9%) reported that there is a TBIC policy within the facility, but most of the responses from the KIIs rather indicated the absence of a TBIC policy in the facility. A survey of knowledge, attitude and practice of staff on TBIC in rural South Africa indicated that insufficient supply of PPEs (respirators) were the perceived barriers to sustained implementation of TB Infection Control (Kanjee et al., 2011). Also, Brouwer and colleagues in their study identified lack of necessary TBIC materials or equipment (respirators and other protective equipment) and lack of clear guidelines as part of the challenges to effective implementation. One of the health care providers stated that, *''There is priority to give respirators to the TB program, isn't it? We, the others, use those of paper that do not protect at all.''* –Medical (Brouwer et al., 2014).

Concerning the periodic screening of staff for TB, majority of the responses indicate that there was no such measure in the facility. However, some of the key informant interviews reveal that such measures exist but poorly patronized due to stigmatization and poor staff attitude. Staff screening was identified as a critical part of reducing TB transmission in healthcare settings (Costa, Silva, Ferreira, & Nienhaus, 2011).

5.4 Environmental Factors Influencing Sustained Implementation of TBIC

All the environmental factors in this study are perceived to be inhibitors rather than promoters of sustained implementation of TBIC measures in the facility. These factors included small waiting area, poor ventilation system, and absence of a well-ventilated sputum booth for safe sputum production and disposal.

Over 50% of the responses from the participants indicate that the sizes of the patients waiting areas are small to accommodate patients without crowding. Similar findings were reported from a study in Mozambique in which it was stated that poor infrastructure, inadequate space and lack of fans were perceived as challenges to use TBIC measures. According to a respondent of that study, *"Our physical space is small. [...] There are no fans, nothing."* –Medical (Brouwer et al., 2014). A study in Uganda by Buregyeya et al., (2013) also showed that less than 50% of patient waiting rooms were adequately ventilated. The small size of the waiting areas can be mainly due to the old facility structure, which was built over three decades ago; however, new facilities are being added to reduce the crowding.

Most (96.4%) of the participants who use natural ventilation report that they "always" open the doors and windows during work hours, compared to a 65.5% and 69.1% recorded for

doors and windows respectively in South Africa (Kanjee et al., 2011). This agrees with the findings from the direct observation at the study site. The high discrepancy may be attributed to the temperate climate of the study location relative to South Africa.

The facility had no vantage point or sputum booth for safe sputum production and disposal; as such, patients are directed to produce sputum samples in open locations, potentially exposing the whole populace to TB nuclei droplets. The unavailability of the booth can be attributed to the lack of space within the facility.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The overall level of knowledge and practice of TB Infection Control measures among Health Care Workers at the Greater Accra Regional Hospital is good. Generally, female health care workers have better knowledge than the males. Current unit of work is significantly associated with level of knowledge. Also, level of knowledge of TB and TBIC, and job category are the main significant predictors of TBIC practice.

The main service factor promoting sustained implementation of TBIC is the screening of suspected TB patients. However, inadequate TBIC materials (TBIC policy, IEC materials and PPEs), lack of an isolation ward and absence of staff screening for TB are perceived to be the major inhibiting factors to effective implementation of TBIC measures.

6.2 Recommendations

1. The Management of the Greater Accra Regional Hospital should work closely with the TB coordinator to ensure periodic staff screening for TB.
2. The Management of the Greater Accra Regional Hospital should provide properly ventilated isolation units for separating infectious TB patients.
3. The HCWs need to be supervised by both hospital management and NTP to ensure that TBIC measures/practices are strictly adhered to within the hospital setting.
4. The National Tuberculosis Programme (NTP) should ensure that adequate logistics (TBIC policy, PPEs and IEC materials) are made available for sustained implementation of TBIC measures.

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APPENDICES

Appendix I: Participant Information Sheet and Consent Form

Title of thesis: "Assessment of Implementation of Tuberculosis Infection Control Measures among Health Care Workers at the Greater Accra Regional Hospital"

Principal Investigator: Portia Dzivenu, P.O. Box KB 143, Korle Bu, Accra, Ghana.
Mobile: +233249047414.

You are being invited to take part in a research project, which forms part of my Masters' thesis titled "**Assessment of Implementation of Tuberculosis Infection Control Measures among Health Care Workers at the Greater Accra Regional Hospital**. The study period is from April 2017 to June, 2017. Please take some time to read the information presented here, which will explain the details of this project. Please ask the researcher any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you in any way. You are also free to withdraw from the study at any point, even after agreeing to participate.

Aim of the study: To assess the implementation of Tuberculosis Infection Control Measures among Health Care Workers at the Greater Regional Hospital.

Procedure: I will be interviewing and/or administering questionnaires to you to gather information on implementation of TBIC among health care workers in this facility. The interview will last about 15 minutes. I will also be observing some of your activities related to TB Infection Control. This observation is to enable me observe the administrative,

environmental and personal protection measures to the implementation of TBIC. Please note that it is not meant to monitor your performance.

Confidentiality and Anonymity: Interview will be conducted in a confined room/environment to ensure privacy and confidentiality. Your responses and information provided during this interview is strictly confidential. Your name will not be linked to your responses as you will be identified only by a study number or code. All recorded tapes, notes and questionnaires will be stored in a cabinet under lock and key, and destroyed after five years.

Benefits: There will be no direct monetary benefit in this study. However, you will be given a souvenir and will get the opportunity to add on to knowledge in the area of TB infection control and its effective implementation for societal benefit.

Cost/Compensation

There is no direct cost to be incurred in this study. The study will also not provide compensation of any form to the participants.

Potential risks or interruption: I understand how busy your schedule might be in executing your duties in the facility (applicable to HCWs only). In the course of the interview, if you need to attend to your duties, please feel free to inform the researcher so you may be excused. Please note that some of the questions may prove uncomfortable to you and you are free to choose not to answer any question as well.

This study has been reviewed and approved by the Ghana Health Service Ethical and Review Committee. Please should you have any question, you may contact: Portia Dzivenu (principal investigator) on +233249047414 or via email: pdzivenu@st.ug.edu.gh**, Prof. Margaret Lartey (UG-Florida, Principal investigator)**

on +233244165851 or Ms. Hannah Frimpong (Ghana Health Service Ethical Review Committee Administrator) on +233507041223.

Declaration by participant

By signing below, I ……..…… agree to take part in a research study entitled "**Assessment of Implementation of Tuberculosis Infection Control among Health Care Workers at the Greater Accra Regional Hospital**

I declare that I understand all that has been explained to me about the study- objectives and procedures and I voluntarily agree to participate in this study.

…….. ……

Signature/Thumb print of participants Date

…… ……

Signature of Researcher Date

Appendix II: Semi-Structured Questionnaire for Health Care Workers (HCWs)

Code: ..... Interviewer: ..... Date:

Dear Participant,

This study aims at assessing the implementation of tuberculosis (TB) infection control measures among health care workers at the Greater Accra Regional Hospital. The questions will require about 15 minutes for completion. The findings of this study will contribute to improving the measures that need to be put in place to reduce the spread of TB in health facilities.

Section A: Socio-Demographic Information

Kindly provide details for the following information. Respond by ticking (√) or writing in the spaces provided.

Age: **Gender:** [a] Male [b] Female

Marital Status: [a] Single [b] Married [c] Separated/Divorced

[d] Widowed [e] Others, Specify .....

Educational Status: [a] No Education [b] Primary [c] Secondary

[d] Tertiary [e] Others, Please Specify .....

Job Category: ..... **Professional Working Years:** .....

Current Unit/Dept.:..... **Job Title:** .....

Number of Years Worked in this Facility: .....

Please do you have any known medical condition (s)? [a] Yes [b] No

If Yes, Please Specify .....

Please specify your knowledge and practice of tuberculosis infection control. Kindly tick (√) appropriate answer (s).

1. How is TB spread?
   a) If uninfected person comes into contact with the blood of person containing the TB bacilli.
   b) When TB bacilli droplets become suspended in the air and someone breaths in the 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. Who are persons with high risk of TB exposure and infection? (Tick all that apply).
   a) Persons who live in crowded, poorly ventilated setting where TB is common
   b) Persons who are immune-compromised, such as HIV/AIDS patients
   c) Persons who are sexually active
   d) Persons who share common cooking ware, utensils and cups

3. What kind of signs/symptoms do you think people with TB have? (Tick all that apply)
   a) Chronic cough (lasting for more than 2 weeks)
   b) Coughing out blood
   c) Frequent urination

d) Night sweats

e) Weight loss

f) Fever

g) Don't know

4. In healthcare setting, who are the persons with the greatest risk for TB spread?

a) Coughing patients who have not been diagnosed as having TB and are not receiving treatment.

b) Health care workers who do not use respirators when attending to TB patients

c) Don't know

d) Other specify.....

5. What is the best and cheapest way of reducing TB bacilli in the air?

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

b) Provide respirators or N95 masks to all staff involved in TB care

c) Install a mechanical ventilation system

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

e) Don't know

6. Does this facility have a general Infection Prevention and Control policy?

a) Yes b) No c) Don't know

If yes, do you have access to the policy? .....

What is the content of the policy?

.....

.....

7. Is there an Infection Control (IC) Policy for TB specifically?

a) Yes b) No c) Don't know

If yes, do you if the TBIC policy has been revised over the past 5 years?

a) Yes b) No c) Don't know

8. Is there an Infection Control (IC) Committee or responsible person for monitoring in place?

a) Yes b) No c) Don't know

9. Have you received any training on TB Infection Control?

a) Yes b) No

If Yes, how often? .....

If Yes, please indicate its usefulness?

a) Extremely useful b) Very useful c) Moderately useful d) Somewhat useful

e) Not useful

10. Does the facility screen staff for TB?

a) Yes b) No

If Yes, on what basis? a) Periodic b) Symptomatic

If Periodic, how often? .....

11. Does the facility have a special care intervention for Health Care Workers who might get infected with TB on the job?

a) Yes b) No c) Don't know

If Yes, what kind of interventions are provided? .....

12. How do you identify suspected TB patients?

.....

.....

13. Are suspected patients screened for TB?

a) Yes b) No c) Don't know

14. What laboratory facilities do you have for TB testing and reporting?

.....

.....

15. Does the facility have a separate laboratory for TB testing and reporting?

a) Yes b) No c) Don't know

16. Are suspected or diagnosed TB patients separated from other patients?

a) Yes b) No c) Don't know

If Yes, is there an isolation ward specifically for TB patients?

a) Yes b) No c) Don't know

17. Does the facility have express treatment ("fast tracking") for smear positive cases to minimize the stay of these patients in the facility?

a) Yes b) No c) Don't know

If yes, what express services do you offer?

.....

18. What do you understand by Cough Etiquette? **(Tick all that may apply).**

a) It is when someone says "excuse me" after coughing in public

b) It should be required of all patients, but not necessary for healthcare workers

c) It is required of all persons in the facility at all times

d) It includes covering your mouth with handkerchief, tissue, or upper arm when one coughs or sneezes

e) It includes washing hands with soap and water after handling respiratory secretions/ cleaning hand with alcohol-based rub or hand sanitizer

f) Putting respiratory secretions in a tissue and then dispose of in a waste bin

g) Don't know

h) Other, specify.....

19. Does the facility have Information, Education and Communication (IEC) materials like posters and signs on cough etiquette?

a) Yes b) No c) Don't know

If Yes, in what instances do you use them? .....

20. Do you provide nose masks or tissues for coughing patients?

a) Yes b) No

21. Does the facility have a well-ventilated sputum booths at vantage points (outdoors in all relevant units)?

a) Yes b) No c) Don't know

If Yes, how often are the sputum samples collected? .....

22. Do you consider the outdoor waiting area of the facility large enough to seat patients without crowding?

a) Yes b) No c) Cannot tell

How many patients can the sitting area seat .....?

23. Do you experience crowding of patients and/or attendants in waiting areas sometimes?

a) Yes b) No

If yes, what accounts for the overcrowding?

.....

.....

24. What kind of ventilation do you use in your facility?

a) Natural ventilation, like windows, doors, etc

b) Mechanical Ventilation like fans, air-conditioners, etc

c) Mixed Ventilation

If Natural Ventilation, how often are the windows opened? .....

25. How often are the mechanical ventilation equipment maintained?

a) 1- 6 months

b) 6-12 months

c) As per breakdown of equipment

d) Don't know

26. Which kind of Personal Protective Equipment (PPE) do you use?

a) Respirators (N95 or FFP2) b) Surgical Masks c) None

27. How would you rate the quantity of PPE (respirators and surgical masks) given to HCWs by the facility?

a) Adequate b) Inadequate c)No PPEs at all

28. What are some of the factors that promote the implementation of TB Infection Control measures in your facility? .....

.....

.....

29. What are some of the factors that inhibit effective implementation of TB Infection Control in your facility?

.....

.....

.....

30. Kindly indicate any further issues, concerns, suggestions you have regarding the effective implementation of TB Infection Control at the Greater Accra Regional Hospital?

.....

.....

.....

Thank you for your kind participation and cooperation!

Appendix III: Key Informant Interview guide

Initials of participants.....

Position/Designation: .....

Age:.....Gender: Male / Female

Level of education: .....

Working years.....

Years/months worked at facility:.....

[1] Do you know if there is any TBIC Measures being implemented in this facility?

Probe: if Yes, When did it start?

[2] How is it being implemented?

Probe: What is the documented TBIC plan in place? What is the composition of the committee in place? How often do they meet if yes?

[3] Who is responsible for the implementation of TBIC Measures in this facility?

Probe: Who does the person report to?

[4] How many times has TBIC Measures being reviewed since its inception?

Probe: Who reviewed it and were the results communicated to you?

[5] What is your role in the implementation of TBIC in this facility?

Probe on perceived role in administrative, environmental and personal protection measures

[7] Have you ever been trained or trained HCWs on TBIC Measures?

Probe: Give details of the training – content, duration, by whom and when

[8] What are the factors facilitating sustained implementation of TBIC in this facility?

[9] What are the challenges you face in the implementation of TBIC?

Probe: can you mention some of them? Interviewer to list examples under administrative, environmental or personal protection measures without leading participants.

[10] What recommendation would you give to improve the implementation of TBIC among Health Care Workers in this facility?

Thank You for your time!

Appendix IV: Direct Observation Checklist

Name of Observer .....

Record time observation starts.....

Record time observation ends.....

General Comments on clinic environment: (Cleanliness, size, patient load at time of observation, observable bureaucracy in HCW/Patient interaction)

For each observation, give observed reason for "Yes" or "No" under "comment"

Code	Activity being observed	Comment
E	Are patients over-crowded in hall ways or waiting areas?	
A	Are patients promptly identified in waiting areas or as soon as they enter clinic?	
A	Are coughing patients promptly attended to by HCWs? (Note how long it took before attending to patient)	
P	Do HCWs involved in TB care wear respirators? (If not, any observable reasons why)	
P	Do HCWs remove respirators sometimes? (Note observable reasons)	
A	Did you observe HCW(s) distributing nose mask/ tissue to patients? (Any shortage observed)	
A	Do patients comply with use of masks or was it removed at any point in time? (Note observable reasons)	
A	Availability of IEC materials for cough etiquette	
A	Are sputum booths available? (Located in clinic waiting room area/ outside waiting room area within premises/ outside premises)	
A	Are sputum samples collected in designated booths? (observe sputum booths and comment)	

Are windows positioned on opposite side of wall?	
Are windows opened daily? (In waiting areas, consultation rooms…)	
nd comment on behaviour of HCWs in carrying out above TBIC ınd interaction with patients (Note promoters and inhibitors to the ıation of TBIC)	

ninistrative measures, E-Environmental measures, **P-Personal Protection measures**

Appendix V: Ghana Health Service Ethical Approval

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Tel: +233-302-681109
Fax + 233-302-685424
Email: ghserc@gmail.com

My Ref. GHS/RDD/ERC/Admin. 1/17/ 837/465
Your Ref. No.

Portia Dzivenu
University of Ghana
School of Public Health
Legon, Accra

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	**GHS-ERC: 37/02/17**
Project Title	Assessment of Implementation of Tuberculosis Infection Control Measures among Health Care Workers at the Greater Accra Regional Hospital
Approval Date	19th April, 2017
Expiry Date	18th April, 2018
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,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report after completion of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
PROFESSOR MOSES AIKINS
(GHS-ERC VICE-CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra

Appendix VI: Approval for Use of Study Site

UNIVERSITY OF GHANA
DEPARTMENT OF HEALTH POLICY,
PLANNING AND MANAGEMENT
SCHOOL OF PUBLIC HEALTH

Ref. No.: .....

November 3, 2016

The Medical Director
Greater Accra Regional Hospital
P. O. Box PMB 214
Accra

Dear Sir,

LETTER OF INTRODUCTION

I wish to introduce to you Ms. Portia Dzivenu, Master of Public Health (MPH) student of the Department of Health Policy, Pla[illegible]ol of Public Health, University of Ghana, Legon. As part of the re[illegible] MPH degree, she is expected to undertake a piece of research to e[illegible]

Her research topic is "Assessment [illegible]culosis Infection Control among Health Care workers at the Gre[illegible]".

I shall be grateful if your outfit co[illegible]information in your facility.

Thank you for your cooperation.

Yours sincerely,

Dr. Reuben Esena
Head of Department

INTEGRI PROCEDAMUS

Head of Public Health
for Your attention
7/6/17

COLLEGE OF HEALTH SCIENCES
• Telephone: +233 (0) 289 109 006 • Email: hppm@ug.edu.gh • Website: www.publichealth.ug.edu.gh
P.O. Box LG 13, Legon, Accra, Ghana