THE DEVELOPMENT AND EFFECTIVENESS OF A STANDARD EDUCATION PROGRAMME TO PREVENT TUBERCULOSIS FOR PUBLIC HEALTHCARE WORKERS IN MALAYSIA

SIVARAJAN A/L RAMASAMY

THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PUBLIC HEALTH

FACULTY OF MEDICINE
UNIVERSITY OF MALAYA
KUALA LUMPUR

2018

UNIVERSITI MALAYA

ORIGINAL LITERARY WORK DECLARATION FORM

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Registration/Matric No: MHC140011

Name of Degree: Doctor of Public Health (DrPH)

Title of ~~Project Paper/Research Report/Dissertation~~/Thesis ("this Work"):

THE DEVELOPMENT AND EFFECTIVENESS OF A STANDARD EDUCATION PROGRAMME TO PREVENT TUBERCULOSIS FOR PUBLIC HEALTHCARE WORKERS IN MALAYSIA

Field of Study: **Occupational Health / Public Health**

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THE DEVELOPMENT AND EFFECTIVENESS OF A STANDARD EDUCATION PROGRAMME TO PREVENT TUBERCULOSIS FOR PUBLIC HEALTHCARE WORKERS IN MALAYSIA

ABSTRACT

Tuberculosis (TB) is a major occupational hazard for healthcare workers (HCWs) worldwide. The main objective of this study is to develop and evaluate the effectiveness of standard education programme to prevent Tuberculosis for public healthcare workers in Malaysia. The health belief model was applied as the main theoretical framework in this study to understand the perception of risk, perception of threat, perception of benefit and cues of action of HCWs on TB disease and prevention. The study duration for cross sectional study took 8 months to complete (January 2016 to August 2016) meanwhile the intervention study was done concurrently, and it took six months (February 2016 to July 2016) to complete the intervention study. First, a cross-sectional study was conducted within 11 states in Malaysia. This study evaluated the association between occupation and knowledge, attitude, and practice (KAP) on TB prevention among HCWs in Malaysia the sample population (n = 3,344) consisted of doctors, nurses, medical assistants, and health attendants. Based on job status, doctors had a positive correlation with KAP, as 68% of doctors had the high knowledge and 69% had good practice; however, the majority of doctors scored in the neutral attitude category. Similarly, there was a strong positive correlation between knowledge and practice among nurses. Nurses demonstrated the highest percentage of good practice compared with other job statuses. Further, the majority of health attendants indicated moderate knowledge with neutral and negative attitudes (90%) and fair and poor practice (33%).Secondly, an educational intervention, STEP, was developed to increase the level of KAP among HCWs on TB disease and prevention. The content and suitability of the STEP programme was validated the by three panel of experts. Thirdly, an intervention study was conducted and STEP programme was delivered based on a participant-centred approach that integrated demonstrations to

evaluate the effectiveness of the STEP programme. Total of 600 nurses from Kedah state participated in this study and participants were randomised into intervention and control group based on block randomisation. The characteristics of both group were similar at baseline. Pre-test and post-test was performed at immediate, one-month and three-months after the course. Results of this study indicated that baseline knowledge of TB is similar in both intervention and control group. Post STEP programme, there was a significant increase in knowledge,attitude and practice mean scores in the intervention group. The result showed that the effect of STEP at post-intervention are improvement of score in knowledge, attitude and practice with 10.43, 9.26 and 1.78 scores. Meanwhile, the effect of STEP in high knowledge, positive attitude and good practice showed significant improvement with odds ratio of 2199.8 ,77.8 and 1.07 respectively in intervention group. The findings showed immediate improvement noted on knowledge and attitude and significant improvement on practice only noted at three months post-intervention. In conclusion, Standard Tuberculosis Education Program (STEP) is effective in improving KAP on TB prevention among HCWs in Malaysia and STEP should be incorporated in current guideline and implemented as a standard health education training programme for HCWs in Malaysia.

Keywords: healthcare workers, Tuberculosis, Knowledge, Attitude, Practice

PEMBANGUNAN DAN KEBERKESANAN PROGRAM PENDIDIKAN STANDARD BAGI PENCEGAHAN TUBERKULOSIS UNTUK ANGGOTA KESIHATAN AWAM DI MALAYSIA

ABSTRAK

Kajian ini menilai hubungan diantara pekerjaan dan pengetahuan, sikap dan amalan (PSA) mengenai penyakit tuberkulosis (TB) and pencegahan di kalangan anggota kesihatan di Malaysia. Pertama, kajian rentas telah dijalankan di 11 buah negeri di Malaysia. Populasi sampel (n = 3,344) terdiri daripada pegawai perubatan, jururawat, pembantu perubatan, dan pembantu perawatan kesihatan. Berdasarkan status pekerjaan, pegawai perubatan mempunyai korelasi positif dengan PSA, kerana 68% pegawai perubatan memiliki pengetahuan yang tinggi dan 69% mempunyai amalan yang baik; Walau bagaimanapun, majoriti pegawai perubatan tergolong dalam kategori sikap neutral. Begitu juga terdapat korelasi positif antara pengetahuan dan amalan di kalangan jururawat. Jururawat menunjukkan peratusan yang paling baik berbanding dengan status pekerjaan lain. Selanjutnya, majoriti anggota kesihatan menunjukkan pengetahuan sederhana dengan sikap neutral dan negatif (90%) dan amalan yang kurang baik (33%). Seterusnya, modul pendidikan kesihatan bagi anggota kesihatan telah direkabentuk bertujuan untuk meningkatkan tahap pengetahuan ,sikap dan amalan di kalangan anggota kesihatan terhadap penyakit TB dan pencegahan. Program STEP disampaikan berdasarkan konsep penglibatan atau pendekatan peserta yang terdiri daripada demonstrasi dan menerapkan PSA dalam aktiviti klinikal seharian. Program pendidikan kesihatan ini termasuk siri ceramah, persembahan video, demonstrasi, dan perbincangan secara berkumpulan. Isi kandungan dan kesesuaian program STEP telah disahkan oleh tiga panel pakar. Seramai 600 orang jururawat dari negeri Kedah mengambil bahagian dalam kajian ini dan para peserta secara rawak dimasukkan ke dalam kumpulan intervensi dan kawalan berdasarkan pembahagian blok. Ciri-ciri kedua-dua kumpulan itu adalah

serupa pada garis dasar. Ujian pra-ujian dan ujian pasca dilakukan secara segera, satu bulan dan tiga bulan selepas kursus. Keputusan kajian ini menunjukkan bahawa pengetahuan asas TB adalah sama dalam kedua-dua kumpulan intervensi dan kawalan. Selepas program STEP, terdapat peningkatan signifikan dalam pengetahuan, sikap dan amalan skor dalam kumpulan intervensi. Keputusan menunjukkan bahawa kesan STEP pada campur tangan selepas itu adalah peningkatan skor dalam pengetahuan, sikap dan amalan dengan nilai 10.43, 9.26 dan 1.78. Sementara itu, kesan STEP dalam pengetahuan tinggi, sikap positif dan amalan baik menunjukkan peningkatan yang ketara dengan nisbah odds masing-masing sebanyak 2199.8, 77.8 dan 1.07 dalam kumpulan intervensi. Penemuan menunjukkan peningkatan serta-merta yang dicatatkan pada pengetahuan dan sikap dan peningkatan yang ketara dalam amalan hanya diperhatikan pada tiga bulan selepas campur tangan. Kesimpulannya, Program Pendidikan Tuberkulosis Standard (STEP) berkesan dalam meningkatkan KAP terhadap pencegahan TB di kalangan HCW di Malaysia dan STEP harus dimasukkan dalam garis panduan terkini dan dilaksanakan sebagai program latihan pendidikan kesihatan standard untuk HCW di Malaysia.

Kata kunci: **anggota kesihatan, t**uberkulosis, pengetahuan, sikap, amalan

ACKNOWLEDGEMENTS

My sincere gratitude first goes to the God for giving me the opportunity to undertake this academic journey and seeing me through to the end. I highly appreciate the valuable assistance and guidance of my supervisors Professor Sanjay Rampal A/L Lekhraj Rampal and Dr Marzuki Bin Isahak, who continuously and tirelessly dedicated a lot of their valued time to advice, guide and give me fundamentals of carrying out this thesis. I could not have completed this work without them.

Above all, I am deeply indebted to all public health specialist from various states and department including disease control unit from ministry of health which includes.Dr Shahida, Dr Priya Ragunath, Dr Fadhli, Dr Haidar, Dr Lutfan, Dr Richard Avoi, Dr Rozaini, ,Dr Syed Mud Puad Syed Amran, Dr Norasmizah, Dr Mazurah, Dr Siti Khadijah, Dr Zukri, SN Noraini and Dr Harish for their support. I would like to thank Associate Professor Dr Sarimah binti Abdullah from University Sains Malaysia for allowing me to use her questionnaire in this study. I also would like to extend my gratitude to all those who participated in this study

I would like to thank my wife, Dakshaini for the support during these long years of my studies as well as my two-lovely princess, Shivani Sivarajan and Dhanya Sivarajan.

Lastly, but not the least, the great cohort in University Malaya! MPH class of 2013 and DrPH class 2014, it has been a wonderful four years together. Been with you has taught me a lot of lessons that will certainly help me in life. I cherish the strong bond of friendship that linked us together despite our different backgrounds. I hope to meet you in the future for more friendship and collaboration.

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LIST OF SYMBOLS AND ABBREVIATIONS

AIDS : Acquired Immune Deficiency Syndrome

AFB : Acid fast bacilli

BCG : Bacillus of Calmette and Guerine

CDC : Center for Disease Control and Prevention

CXR : Chest X-ray

DOT : Directly Observed Treatment

HIV : Human Immuno-Deficiency Virus

IC : Infection control

MDR-TB : Multi-Drug Resistant TB

MIC : Minimum inhibitory concentration

MTB: Mycobacterium tubercle bacilli

TB : Tuberculosis

WHO : World Health Organization

Active TB : Active tuberculosis disease

AFB : Acid fast bacilli

BCG : Bacillus Calmette-Guérin

CDC : Centers for Disease Control and Prevention

CXR : Chest X-ray

DM : Diabetes mellitus

DOTS : Directly observed treatment, short

EPTA: Extra Pulmonary Tuberculosis

HIV : Human immunodeficiency virus

HCW : Health care workers

KAP : Knowledge, attitude, practice

LTBI : Latent tuberculosis infection

MDR-TB : Multidrug Resistant Mycobacterium tuberculosis

MTB: Mycobacterium tuberculosis

MOH : Ministry of Health Malaysia

PTB : Pulmonary tuberculosis

SPSS : Statistical Package for Social Sciences

TB : Tuberculosis

TBIS :Tuberculosis Information System

TST:Tuberculin skin test

WHO:World Health Organization

XDR-TB :Extra drug resistant Tuberculosis

ZN :Ziel Neelsen staini

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

1.1 Introduction to Tuberculosis (TB)

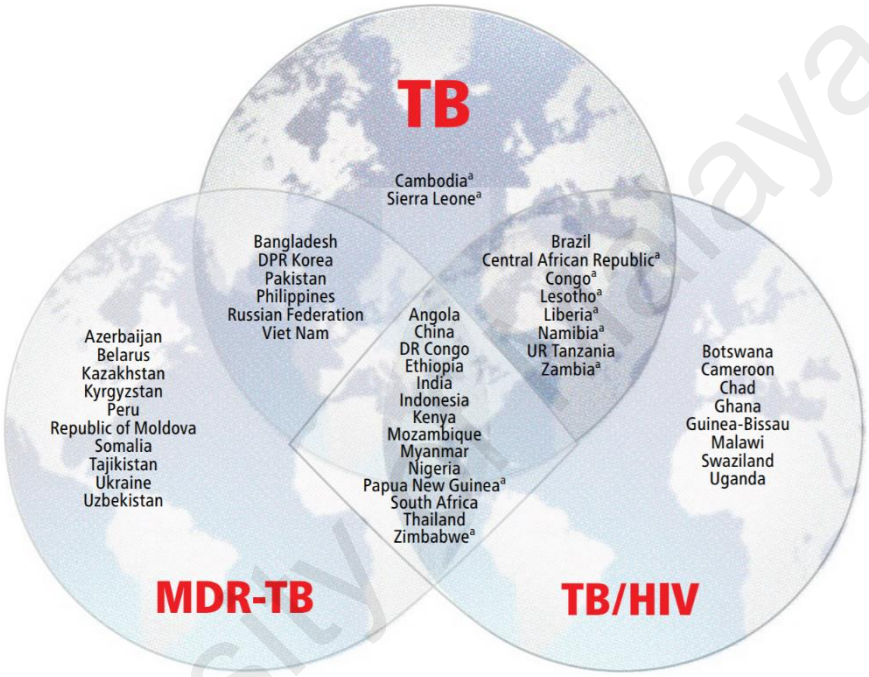
Tuberculosis (TB) is caused by a bacterium called mycobacterium TB (MTB), which mainly affects and presents in the lungs, resulting in pulmonary TB. However, TB can also manifest in other parts of the body, such as the kidneys, brain, and spine (through the lymphatics and blood vessels). When these other areas are affected, the disease is known as extrapulmonary TB.

1.2 Global Epidemiology of TB

The WHO estimates that approximately one-third of the world's population has been infected with TB. The causative agent, MTB, has resulted in significant mortality and morbidity rates among healthcare workers (HCWs) worldwide, mainly in middle- and low-income countries.

TB has existed for more than 100 years and is currently one of the leading causes of mortality worldwide, affecting approximately 10 million patients every year. The WHO End Tuberculosis Strategy by the World Health Assembly, participated in by 194 member states, set a goal for 90% reduction in TB mortality and 80% reduction in TB incidence rate by 2030. Based on this strategy, the targets for the year 2035 are a 95% reduction in TB deaths and a 90% reduction in the TB incidence rate, compared with levels in 2015. The short-term goal, set for 2020, is a 35% reduction in TB deaths and a 20% reduction in the TB incidence rate, compared with levels in 2015.

Figure 1.1 illustrates which countries comprise the three high-burden country lists for TB, TB/HIV, and MDR-TB (WHO,2006). Although Malaysia does not appear in any of the categories, the country borders high-burden TB countries, such as Thailand, Indonesia, the Philippines, Myanmar, and Vietnam. These countries have a close relationship with Malaysia in terms supplying workforce into Malaysia in various categories, including construction, agricultural, and services.



DPR Korea, Democratic People's Republic of Korea; DR Congo, Democratic Republic of the Congo; HIV, human immunodeficiency virus; MDR, multidrug-resistant; TB, tuberculosis; UR Tanzania, United Republic of Tanzania; WHO, World Health Organization.
[a] Indicates countries that are included in the list of 30 high TB burden countries on the basis of the severity of their TB burden (i.e. TB incidence per 100 000 population), as opposed to the top 20, which are included on the basis of their absolute number of incident cases per year.

Figure 1.1: Countries in the three high-burden country lists for TB, TB/HIV, and MDR-TB during the period 2016-2020 (WHO, 2016)

TB incidence in 2016 for countries with at least 100,000 cases has been estimated to range from 100,000 to 2.5 million cases (Figure 1.2). Geographically, many of the countries with high incidence TB are neighbours to Malaysia, such as Indonesia, Thailand, and the Philippines (W.H.O, 2016). Based on Department of Statistics Malaysia and the National Labour Survey 2014, the migrant population in the year 2014 were 3.1 million migrant workers in Malaysia. Therefore, it is projected that the migrant population in 2034 will be approximately 7.5 million (National Labour Survey, 2014). Currently, approximately 44% of foreign workers in Malaysia are from Indonesia, followed by

Nepal, Myanmar, Bangladesh, India, Pakistan, and the Philippines. Notably, the majority of foreign workers were from TB high-burden countries. In addition, the re-emergence of HIV infection leads to re-emergence of TB infection all over the world due to high risk of co-infection. (W.H.O, 2016)

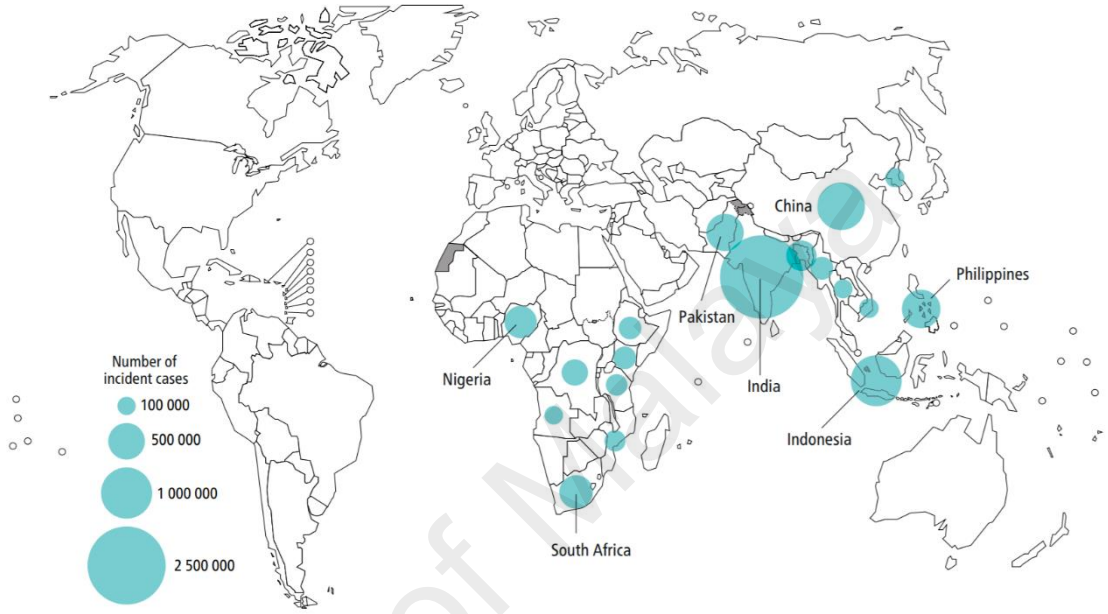


Figure 1.2: Estimated TB incidence in 2016 for countries with at least 100,000 incidence cases (W.H.O, 2016)

1.3 Epidemiology of TB in Malaysia

Malaysia was categorised as an intermediate-burden country based on detecting new and relapse cases of less than 100 cases per 100,000 population (WHO, 2016). However, there was an improvement in detection of new and relapse cases of approximately 6%-10% annually for the past five years. The main contributing factors in disease manifestation in Malaysia are diabetes, smoking, alcohol abuse, and other immunosuppressed diseases, e.g., HIV, cancer, and COPD (S.M. Liew, 2015).

In Malaysia, the incidence of TB cases in 2016 was 25,739 cases, with 86% being pulmonary TB. The incidence of multidrug resistance (MDR) cases in 2016 was 570 cases with an incidence rate of 1.8 per 100,000 population. This number of cases and incidence

rate is increasing progressively as there were only 370 cases in 2015. (M.O.H. Malaysia, 2017)

An increasing number of foreign workers is directly associated with a rise in the prevalence of communicable diseases. According to Unitab Medic, 2014 results showed that the most prevalent communicable disease among foreign workers was TB with 47% or 17,981 foreign workers infected, followed by Hepatitis B with 11% or 4,203 foreign workers. Based on the Ministry of Health (MOH) report (2015), 17,981 foreign workers were diagnosed with TB in 2015 compared to 9,255 cases in 2010. (Unitab, 2014)

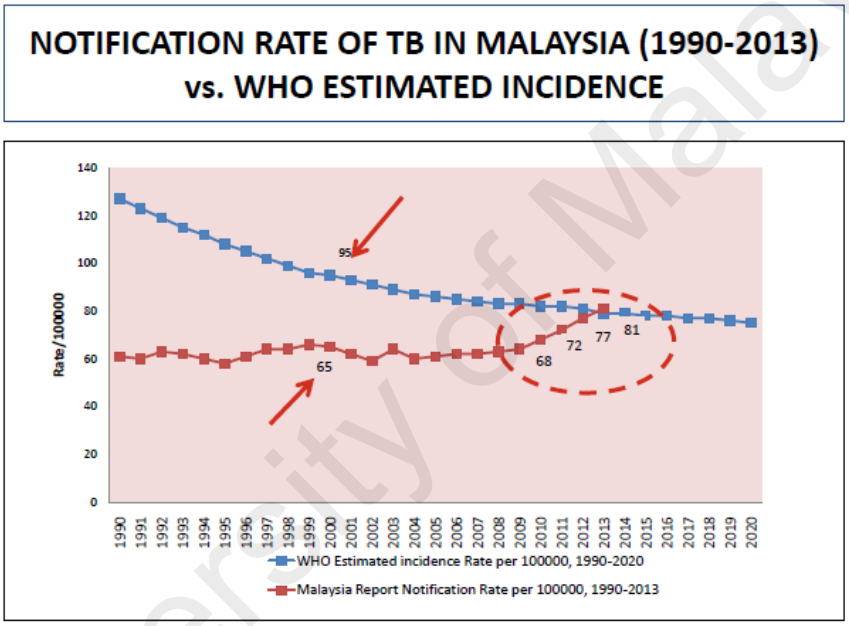


Figure 1.3: Notification rate of TB in Malaysia in Malaysia vs WHO estimations from 1990 to 2013. (M.O.H Malaysia, 2015)

The notification rate of TB among the Malaysian population as compared with the WHO's estimated incidence shows that in the early 1990s, Malaysia had a lower rate; however, it showed a progressive increase into the next decade (Figure 1.3). In 2016, the notification rate in Malaysia was equivalent to the WHO's notification rate. There are multiple reasons for this scenario. Firstly, there have been increasing numbers of TB cases in Malaysia, and secondly, there has been both an increase in the incidence of HIV cases in Malaysia and a high influx of foreign workers.

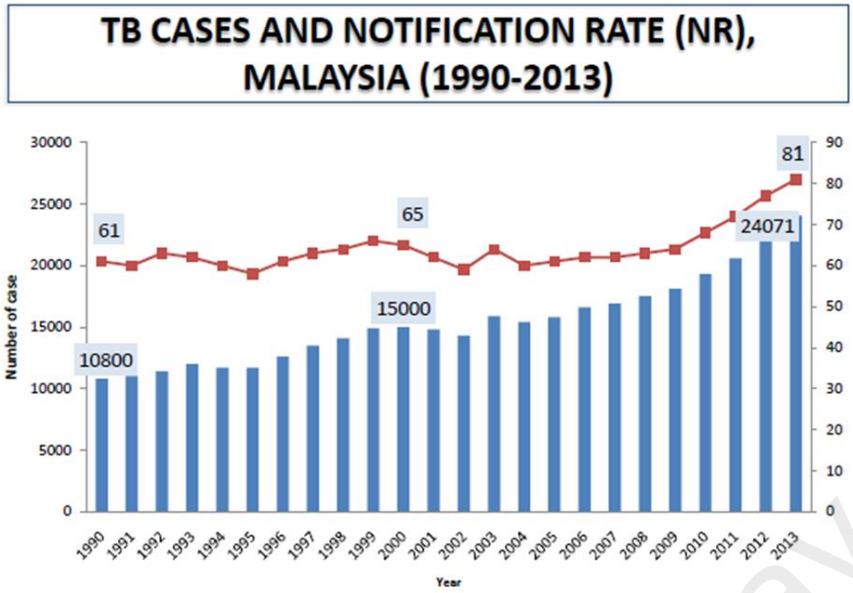


Figure 1.4: TB cases and notification rate in Malaysia from 1990 to 2013

Figure 1.4 indicates that the TB notification rate in the general population in Malaysia has increased from 61 per 100,000 population (10,800 cases) in 1990 to 81 per 100,000 population in 2013 (24,071 cases). Notably, notification rate is used as the benchmark because all confirmed cases of TB are recorded to comply with the Prevention and Control of Infectious Diseases Act 1988 (Act 342).

MDR-TB MALAYSIA, (2004-2013)

Year	Notified TB Cases (All Forms)	Isolates tested for DST	MDR Cases	% MDR (By number of culture positive tested for DST)
2004	15429	5083	13	0.3
2005	15875	6309	17	0.3
2006	16665	6386	42	0.7
2007	16918	6687	41	0.6
2008	17506	6264	56	0.9
2009	18102	7137	55	0.8
2010	19337	6963	51	0.7
2011	20666	10477	141	1.3
2012	22710	9722	74	0.8
2013	24071	16546	121	0.7

Figure 1.5: Multidrug-resistant TB in Malaysia from 2004 to 2013

Multidrug-resistant TB (MDR-TB) cases in Malaysia are also showing an increasing trend (Figure 1.5). In 2004, only 13 cases of MDR-TB were reported, but this figure increased to 121 cases in 2013 (MOH, 2014). Greater incidences of MDR-TB cases will complicate the direct contact HCWs require during diagnosis and treatment. If HCWs acquire the disease from these multidrug-resistant cases, it would increase the disease burden and treatment requirements, leading to an increase in mortality. Higher numbers of multidrug-resistant cases also lead to prolonged hospital stays and treatment, which equals extended contact with HCWs and public healthcare facilities. This condition potentially places HCWs at significant risk of contracting TB, made worse by the risk of contracting MDR-TB in the workplace. MDR-TB is more challenging to diagnose and treat; thus, treatment and management outcomes for are poor around the world, including in Malaysia.

1.4 Significance of this Study

Health education on infectious disease and prevention was a neglected component of most HCWs' training (Affonso et al., 2004; Bennett & Mansell, 2004; Quah & Lee, 2004; Twu et al., 2003; Wenzel & Edmond, 2003; Wurts, Dolan, O'Neal, & Azarcon, 1994). Similarly, in Malaysia, health education on TB was not emphasized as an essential training for healthcare workers. This scenario was proven whereby currently, there is no standard health education programme on Tuberculosis for healthcare workers in Malaysia. Each state in Malaysia conduct Tuberculosis and infection control courses with their respective methods and contents. Each state courses will be conducted by various units eg: Healthcare workers in Perak, Terengganu, Kelantan and Selangor, tuberculosis prevention courses conducted by TB unit or Communicable disease unit of respective state health department which emphasize more on the Tuberculosis disease transmission, diagnosis and treatment.

Meanwhile other states such as Negeri Sembilan, Wilayah Persekutuan. Melaka and Penang, health education training on TB and TB prevention by Occupational Health unit of respective state health department which emphasize mainly on TB prevention and control measures. The target population or participants are also varying from each state. The methods of training in TB health education also differs from every state whereby states such as Negeri Sembilan and Selangor emphasize on hands on demonstration and on field training and courses in Perak and Melaka emphasize on lectures and presentation. The duration of the curse also differs from each state from half days course (4 hours course) to full day course (8 hours course). Therefore, it is essential to develop a standard health education programme on TB for healthcare which includes optimum contents for training and the best methods of delivering the programme for healthcare workers to ensure maximum impact from the programme.

Currently, there is no baseline data available on knowledge, attitude and practice on Tuberculosis for healthcare workers in Malaysia. Based on literature review, some studies were done among nurses in Hospital University Sains Malaysia. Besides this there is no other study to assess KAP on TB among HCWs in Malaysia. There are many courses and health education training was done by each state for their healthcare workers and no baseline data available. Therefore, this study will fill the current gap to understand better the current level of KAP. The outcome of this result will assist in developing right health education programme.

Besides that, in 2012, Ministry of Health Malaysia published a guideline on Guideline on Prevention and Management of Tuberculosis for healthcare workers in Ministry of health Malaysia. This guideline list training and education as one of the prevention method however there was no elaboration and proposed an effective Tuberculosis health education that can be used as standard health education to all the states in Malaysia

TB is one of the leading communicable diseases in Malaysia and it remains a significant public health problem even with the adoption of multiple control measures. The incidence of TB in Malaysia has been caused in part by the high influx of foreign workers to Malaysia from high TB-burden countries. Additional concerns include the presence of illegal workers, the increasing trend of HIV patients, and the worrying trend of TB drug-resistance.

In Malaysia, 95% of TB patients received treatment in public healthcare facilities based on the Directly Observed Treatment Short Course (DOTS) treatment strategy. However, this strategy has led to increased exposure to HCWs, especially in the early stage of active treatment. Based on information from the MOH TB Information System (TBIS), the incidence rate of pulmonary TB disease among HCWs was higher compared with the general population from 2002 until 2016 (73.4–79.7 per 100,000 and 60.3–62.6 per 100,000, respectively). In 2016, the mortality rate was 4.1/100,000 among HCWs in

Malaysia and the number of cases of pulmonary TB among HCWs increased from 31 cases in the year 2002 to 278 cases in the year 2016. This situation is alarming given the high number of HCWs infected with TB. Most of these professionals work with TB patients within public healthcare facilities. In the year 2012, the MOH Malaysia under the Occupational and Environmental Health Unit (OHU) introduced a screening programme to perform screening with the tuberculin skin test (TST) for early detection of TB cases.

In Malaysia, according to the Occupational Safety and Health Act (OSHA, 1994), the employer is responsible for providing a safe and healthy workplace to their employees. This action includes avoiding occupational diseases arising from the workplace. The MOH Malaysia has introduced and implemented control measures to reduce the number of TB cases by implementing engineering controls to ensure proper ventilation that directly reduces the bacterial load, enforcing administration control, and providing training and monitoring to HCWs. Moreover, a written TB infection control programme and audits have been introduced to ensure the policy is enforced and practised in the workplace. Despite this effort that began in early 2000, the number of cases of TB is still increasing every year.

The long-term goal of this thesis is to contribute to the MOH and appropriate authorities to develop and adapt our intervention programme to improve knowledge on TB among HCWs, which will lead and guide to an increase in knowledge, positive attitude, and good practice concerning TB prevention. The impact of this study has the potential to reduce the risk of occupational TB transmission among HCWs and directly reduce the incidence of pulmonary TB among HCWs in Malaysia.

1.5 Study Contribution

This study provides an opportunity to assess the knowledge, attitude, and practice (KAP) concerning TB and preventive measures among HCWs in Malaysia. These

findings will provide baseline information and assist in identifying the knowledge gap, leading to improvement by upgrading the current guideline of prevention and treatment of TB among HCWs. The upgrade includes the introduction of programmes and teaching modules on TB and control measures to prevent TB based on the findings of this study. This action will ultimately reduce the incidence of pulmonary TB among HCWs and ensure that these professionals are working in a healthy environment.

HCWs are valuable assets who provide their service to the public for the prevention and management of health problems, such as injuries or diseases. Therefore, by reducing the incidence of TB among HCWs, it will directly reduce the government burden concerning high medical costs and work absenteeism. In addition, healthy workers increase productivity by delivering their best service to their patient. Undoubtedly, HCWs with TB, especially with MDR-TB, will contribute to a serious issue regarding transmission of the disease to other susceptible patients or HCWs in hospitals or wards.

1.6 Objectives

1.6.1 General Objective

1. To develop and evaluate a Standard TB Education Programme (STEP) for TB prevention (**general objective**).

1.6.2 Specific Objectives

2. To determine the association between job status and knowledge on TB prevention among HCWs in Malaysia.
3. To determine the association between job status and attitude on TB prevention among HCWs in Malaysia.
4. To determine the association between job status and practice on TB prevention among HCWs in Malaysia.
5. To develop a Standard TB Education Programme (STEP) for TB prevention.

6. To evaluate the effectiveness of the STEP programme to improve KAP on TB prevention among HCWs in Malaysia.

1.7 Research Questions

Three research questions guided this research:

1. What is the current level of KAP regarding TB prevention among HCWs in Malaysia?
2. What is the association between job status and KAP concerning TB prevention among HCWs in Malaysia?
3. Does the STEP improve KAP concerning TB and prevention among HCWs in Malaysia?

1.8. Research Hypotheses

Three research hypotheses were proposed and tested in this research project:

1. Participants who take part in the STEP programme will have higher scores on knowledge of TB and prevention than participants who have not participated in the programme.
2. Participants who take part in the STEP programme will have higher scores on attitude towards TB and prevention than participants who have not participated in the programme.
3. Participants who take part in the STEP programme will have higher scores on practice on TB and prevention than participants who have not participated in the programme.

1.9 Thesis Structure

This thesis is presented in six chapters. Firstly, Chapter One elaborated on TB among HCWs globally and in Malaysia specifically. Furthermore, this chapter explained the aims of this research and its objectives.

Chapter Two provides a review of the existing scientific literature and current research regarding KAP regarding TB among HCWs and examines the effectiveness of infection control education. Further, it introduces the conceptual framework employed for this study.

Chapter Three discusses the first objective of this study, which is a cross-sectional study to determine the association between occupation and KAP on TB prevention among HCWs in Malaysia. This chapter also explains in detail the sampling, recruitment process, instrument development, strategy for data collection, statistics used for data analysis, elaboration of the results, and discussions of the study.

Chapter Four describes and elaborates on the development of a TB education programme, the STEP. This section answers the second objective, which is to develop

and evaluate the STEP for TB prevention, including explanations of the development of the programme, its content, and associated teaching and learning activities.

The implementation and evaluation of the effectiveness of STEP programme to improve KAP on TB among HCWs through experimental study among nurses is reported in Chapter Five. Also described in this chapter are the sampling procedures, recruitment process, instrument development, strategy for data collection, statistics used for data analysis, results regarding the effectiveness of the STEP, discussions, and conclusion of the study. This chapter also provides details of the sample characteristics, the difference between the experimental and control groups in terms of baseline data, and the findings of KAP based on the hypotheses proposed in this research.

Chapter 6 identifies the limitations, evaluates the conclusions of the current research, and highlights the implications of these findings for further research and clinical practice.

CHAPTER 2: LITERATURE REVIEW

2.1 Transmission of TB

HCWs are categorised as a high-risk group for TB; therefore, it is important to understand how this disease is transmitted, especially within the healthcare setting. TB is transmitted through tiny droplet nuclei when someone with active TB coughs, sneezes, talks, or sings, specifically in poorly ventilated areas. It only takes the inhalation of a small amount of TB bacilli (droplets) to cause infection; however, only 15% of individuals infected with TB will develop active TB. The chances or risk of developing TB infection is higher in those who have regular direct contact, longer duration of contact, and high intensity of contact with a TB patient. It is understandable how HCWs are at risk of infection and disease. One study showed that each infected person could transmit to approximately 10 to 15 people per year if they do not receive adequate TB treatment (Maher, 2009). An individual with latent TB has a 5% to 10% chance of developing active TB in their lifetime, especially those with low immunity and other factors that increase the risk of developing TB (MMWR, 2000). In particular, this risk is higher in HIV-positive individuals and those with diabetes (Ayuk, 2012). Individuals infected with both TB and HIV are estimated to be 21 to 34 times more likely to develop active TB compared with those without HIV (Luetkemeyer, 2013).

Several studies, including data from Malaysia, have identified through DNA fingerprinting that 30% to 40% of active TB cases are due to recent transmission instead of reactivation of latent infection. This finding indicates the potential high risk of transmission in healthcare settings with poor implementation of infection control measures.

2.2 TB in Healthcare Workers

Prior to the 1920s it was believed that HCWs were not at risk of developing TB through their work environment. The first documented evidence noting the transmission of pulmonary TB disease to HCWs occurred in the 1920s in Norway by Heimbeck. Later, Heimbeck and associates conducted a large study with British HCWs and found that the rate of being infected with TB was greater among healthcare workers (Heimbeck, 1952).

The focus previous work has been on HCWs in low-incidence settings; however, there is a lack of information available on the incidence of TB among HCWs, especially in low-income settings. Notably, two systematic reviews were published in 2006 and 2007 that reviewed more than 20 articles on TB in HCWs primarily in low- and middle-income countries. Most of the reviewed studies had found that the incidence of TB disease among HCWs was higher than the incidence of TB in the general population (Baussano, 2011; Jelip, 2004; Joshi, 2006; Tudor, 2014).

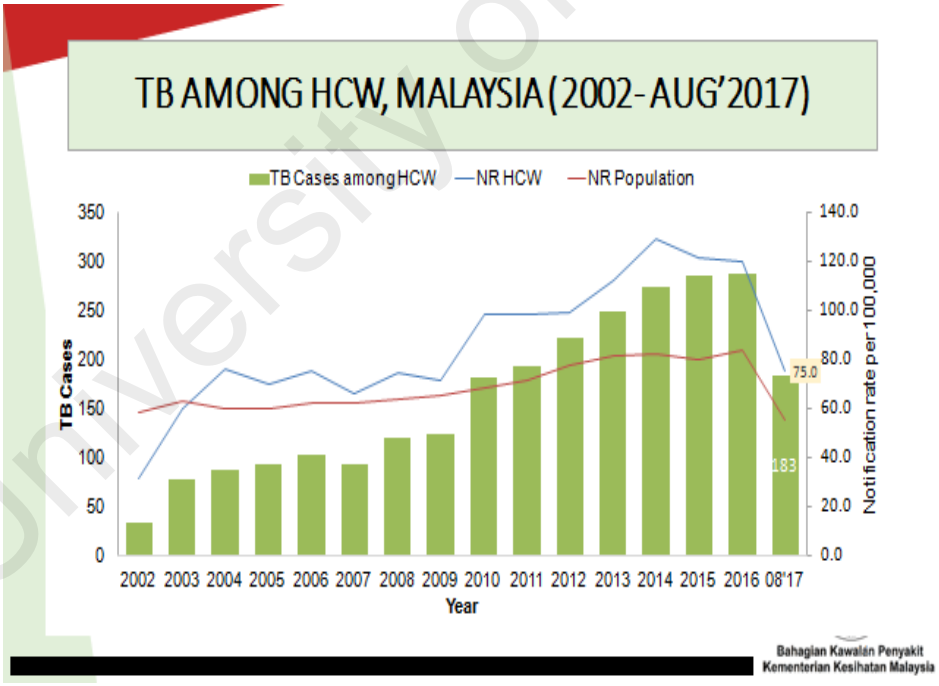
In contrast, two studies from South Africa and Russia found higher rates of TB in the general population compared with HCWs (Balt, 1998; Dimitrova, 2005). Nevertheless, the systematic review research by Menzies and colleagues (1999) concluded that the expected risk of TB in HCWs is three times higher than the general population (Menzies et al., 1999) Additional studies have reached a similar conclusion that HCWs have a greater risk of TB compared with the general population, and that HCWs acquired TB from interacting with an infected patient in their healthcare facilities.

One of the main causes of transmission within healthcare is due to poor infection control practices and implementation of control measures in the workplace (Harries, 2002; Jelip, 2004; Luksamijarulkul, 2004; Roth, 2005; Teixeira, 2005; Yanai, 2003). A selection of studies has explored the specific occupation risk of TB among HCWs in facilities, focusing on certain categories, such as doctors, laboratory technicians, nurses, and other healthcare occupations (Joshi,2006; Baussano, 2011). Further, other

professionals such as paramedic officers, laboratory technicians, and radiologists presented with a greater incidence of TB compared with clinical staff (Joshi, 2006). However, other studies have noted higher rates in less skilled healthcare workers (Costa, 2011).

In Malaysia, the incidence and prevalence of TB among HCWs has increased through the years. Specifically, findings from the MOH have indicated that the notification rate of TB was consistently higher among HCWs compared with the general population from 2002 to August 2017 (MOH, 2017). From Figure 2.1, we can see that the number of TB cases among HCWs steadily increased until 2010 followed by a sudden increase of cases until 2016. In 2017, 264 cases of HCWs with TB were recorded. Moreover, the gap between these groups drastically increased between 2010 and 2016.

Figure 2.1: TB among HCWs in Malaysia from 2002 to 2017 (MOH, 2017)



2.3 Knowledge, Attitude, and Practice (KAP) among Healthcare Workers

2.3.1 History of KAP surveys

KAP surveys were first developed in the 1950s and after 1960, they were mainly used for family planning research in many countries. KAP studies are very economical and effective in terms of cost and resources compared with any other research method (Eckman & Walker, 2008), and this theoretical framework has been widely used, specifically in health education (Jaccard, Dittus, & Gordon, 1996). However, currently, KAP surveys are widely used for research concerning human behaviour and specific diseases or conditions.

2.3.2 KAP survey methodology

The study showed that KAP are interrelated and, in particular, knowledge and attitude have a direct influence on practice (Jaccard, Dittus, & Gordon, 1996). The knowledge component in surveys assesses facts, information, and skills of an individual concerning a specific condition or disease. Meanwhile, the attitude component measures the way of thinking or feeling about a specific condition or disease, and practice assesses the application of preventive behaviour to avoid a specific condition or disease. In particular, the WHO initiated advocacy, communication, and social mobilisation (ACSM) activities in TB control at the country level. ACSM strategies recognise that KAP is a key instrument and tool to understand the perception of the specific country population on TB (PAHO, 2005; WHO, 2006a, 2006b).

Currently, there is no standard organised health education on TB for HCWs in Malaysia. Furthermore, a study showed that in a low-burden country, emphasis on and exposure to TB from either training or professional experience might be minimal, which may affect the management of TB. However, findings of KAP surveys of TB among HCWs in various settings do not provide substantial evidence to support or oppose this assumption, as findings are somewhat conflicting. For instance, research conducted in Oman showed that poor levels of knowledge were found among general practitioners (Al-

Maniri et al., 2008), whereas in Argentina, almost 100% of their physicians correctly recognised the primary symptoms associated with TB (Maria, 2009). Inconsistent findings have also been documented among countries with comparatively high burdens. For example, one study in Iraq showed that almost all physicians reported having good knowledge on TB (Hashim,2004), whereas, knowledge level among physicians in Brazil and Nairobi were suboptimal. A comparative study that assessed the knowledge and practice of medical students with variable levels of exposure to TB in endemic and non-endemic areas revealed that good knowledge was inversely associated with a good practice. This finding was consistent across other studies where, despite high levels of knowledge, desirable practices among physicians were low. Therefore, it is reasonable to conclude that even though knowledge is critical, it may not be the most influential factor in behaviour. However, a limitation of several studies was that only one facet of behavioural influences was assessed, which might have a limited understanding of other contributing factors that also directly affect TB control activities among health staff (CDC, 2005).

The study showed that not an individual indicator could be proven and reliably used to understand the factors influencing the level of KAP on TB and prevention among HCWs in Malaysia. Therefore, it is necessary to determine this information within a local population to identify country-specific weakness and limitation in TB knowledge, cultural beliefs, and practices on disease prevention. As such, this research study employed the health belief model (HBM), which focuses on six factors believed to determine behaviour, namely perceptions of susceptibility, benefits, severity, and barriers, and cues to action, and self-efficacy. The completion of this survey provides baseline information of the current level of KAP on TB among HCWs in Malaysia and this information can be used for comparison with subsequent, post-intervention KAP surveys.

2.4 The HBM (Theoretical Framework)

Several theoretical models have been designed to predict and explain health-related behaviours. In particular, the HBM, developed in the 1950s, has been the most widely used model in health behaviour research. The HBM was initially developed to understand why people failed to use a free screening programme for TB. Subsequently, it has been used to predict several health-related behaviours, including screening for breast cancer, receiving immunisation, injury prevention, and life behaviours, such as sexual risk behaviours. The model is based on the concept that health behaviour is determined by an individual's beliefs about disease and his/her perceptions about the benefits of taking action to control them. The original model included four constructs: perceived barriers, benefits, susceptibility, and severity. However, two additional constructs, namely cue to action and self-efficacy, were added to the later versions of the model.

Some studies have examined the behaviour of individuals who may be at-risk for developing diseases. These studies used the HBM to understand people's decisions about the use of preventive health behaviours. Behavioural scientists and HCWs identified an increasing need to understand what conditions lead an individual to act to prevent, detect, or treat diseases.

Health-related behaviour was seen as an important issue for those who are providing healthcare services. The term health-related behaviour refers to a group of behaviours that include the areas of health, illness, sick roles, chronic illness, and at-risk behaviours (Janz & Becker, 1984). Although the model was originally designed to explain preventive health behaviour, several investigators, such as Kasl and Cobb (1966), Rosenstock (1974), and Kirscht (1974), have suggested its use to explain other health-related behaviours, including at-risk behaviour. This study was most interested in examining the at-risk healthcare worker. Baric (1969) described people at-risk as "those

who are engaged in certain activities, which increase their risk to a much higher degree than the rest of the population".

The HBM has several assumptions as described by Rosenstock (1974):

1. For the individual to take action to avoid disease, the individual must believe that he or she was personally susceptible to it.
2. The occurrence of the disease would have at least moderate severity on some component of the individual's life, and that taking a particular action would, in fact, be beneficial by reducing his or her susceptibility to the condition, or if the disease occurred, by reducing its severity, and that it would not entail overcoming important psychological barriers, such as cost, conveniences, pain, or embarrassment.
3. As a requirement, the individual must believe that the disease or condition can be present even in the absence of symptoms.

Social scientists working with the HBM later developed four constructs from these assumptions, which include perceived susceptibility, severity, benefits, and barriers (Rosenstock, 1974). The first construct of the HBM is perceived susceptibility, which refers to the individual's subjective perception of the risk of contracting a disease or condition. The second construct, perceived severity, assumes that the individual perceives illness as an undesirable state and, furthermore, the individual prefers an illness-free state. This may not be true for all individuals since the illness role also provides benefits that may be attractive to some individuals. The third construct is perceived benefits, which states that the individual is expected to perceive the illness and accept the recommended health action as feasible and efficacious. Kasl and Cobb (1966) noted, "Successful treatment almost always depends on the initiative of the patient seeking 18 diagnoses and treatment". The construct of perceived benefits expects that the individual is rational when seeking healthcare. Although some individuals are rational, some are consistently

not rational or may be intermittently rational. Baric (1969) supported this assumption by stating, "The decision on whether to undertake an action or not depends not only on the kind of information but also on the state in which the recipient of the information finds himself at that time". Perceived barriers are the fourth construct of the HBM and includes potential negative aspects of a health action that may act as an impediment to taking the recommended behaviour. The individual weighs the action's effectiveness against the perception that it may be expensive, have side effects, be unpleasant, inconvenient, time-consuming, etc.

Rosenstock (1974) noted that in addition to the four constructs of this model, some stimulus was necessary to trigger a decision-making process. It appears that this "cue to action" is necessary for an individual to seek healthcare or avoid the activity that places the person in an "at-risk" role. The construct "motivation" was added later to the model referring to a generalised intent that results in behaviours to maintain or improve health (Becker, Drachman, & Kirscht, 1972).

This current study attempted to determine the extent to which HCWs who are at risk for TB have adequate knowledge of the disease and preventive measures. In addition, these beliefs and attitudes concerning TB might contribute to practice on TB prevention and universal precaution. This study focused on KAP in relation to TB and prevention among HCWs, and built on the work of Becker et al. (1990) to examine perceived severity and motivation (Figure 2.2.).

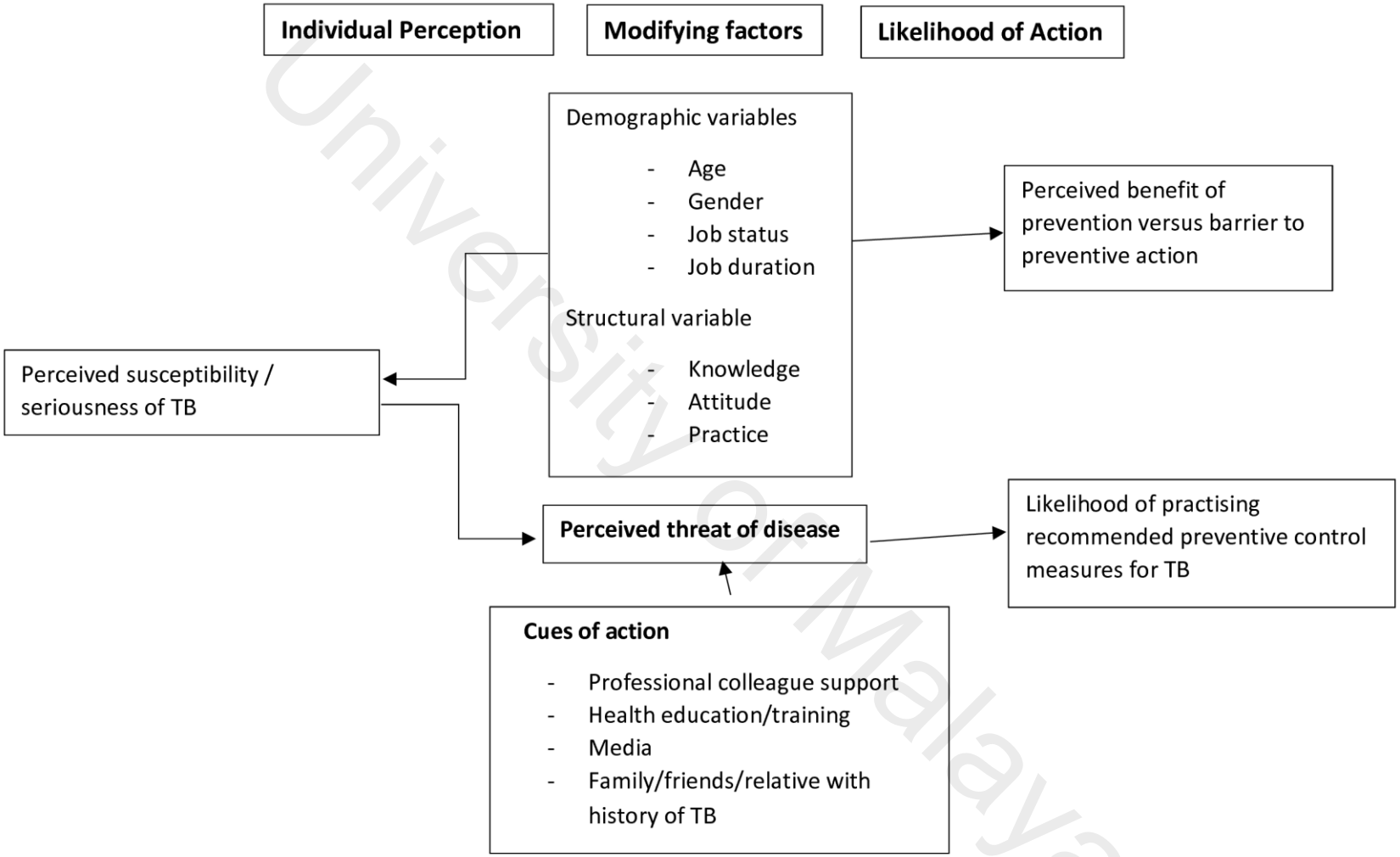


Figure 2.2: The HBM and TB prevention

TB knowledge, prevention practices, and the associated demographic factors in relation to Health Belief Model (HBM) constructs have never been explored among healthcare workers in Malaysia. In this study, using the HBM constructs, we attempted to find out individuals' perceived TB threat and their practices for the prevention of TB. The HBM constructs can be used to predict why healthcare worker's act to control or prevent a particular illness or disease. These constructs are perceived threat of a particular condition, perceived benefits and barriers, perceived self-efficacy (ability to avoid TB through preventive practices), and cues to action (measures that may increase awareness and readiness in executing preventive practices). These factors could guide the design of Tuberculosis-related targeted interventions and the development of an effective educational/awareness program for the targeted population.

Cues of action

This study explores the measures that may increase awareness and readiness in executing preventive practice. The health belief model posits that a cue, or trigger, is necessary for prompting engagement in health-promoting behaviours. (Janz, Nancy K.; Marshall H. Becker,1984.) Cues to action can be internal or external. (Carpenter, Christopher J.,2010). Physiological cues (e.g., pain, symptoms) are an example of internal cues to action. (Glanz, Karen; Barbara K. Rimer; K. Viswanath, 2008). External cues include events or information from close others, the media, or health care providers promoting engagement in health-related behaviors.(Janz, Nancy K.; Marshall H. Becker,1984.(Examples of cues to action includes health education training, professional colleagues training and support, the illness of a friend or family member with TB and media plays an important role in increase awareness on TB prevention practice. The intensity of cues needed to prompt action varies between individuals by perceived susceptibility, seriousness, benefits, and barriers. (Rosenstock, Irwin,1974) For example, individuals who believe they are at high risk for a serious illness and who have an

established relationship with a primary care doctor may be easily persuaded to get screened for the illness after seeing a public service announcement, whereas individuals who believe they are at low risk for the same illness and also do not have reliable access to health care may require more intense external cues in order to get screened.

Perceived benefit

Perceived benefits are defined as beliefs about the positive outcomes associated with a behaviour in response to a real or perceived threat. The perceived benefit construct is most often applied to health behaviours and is specific to an individual's perception of the benefits that will accrue by engaging in a specific health action. Perceived benefit applied in TB prevention for example, perceived benefits of wearing personal protective equipment such as face mask and N95 face mask will protect and prevent from TB droplet transmission from TB patients. Besides that, TB screening by healthcare workers will able to detect TB disease early. The perception of benefits is theoretically linked to the HCW's beliefs about their own outcomes-not those that might occur for others. Thus, a HCW could feel that wearing personal protective equipment such as face mask and N95 face mask will protect and prevent from TB droplet transmission from TB patients for others but not necessarily believe it would do so for themselves.

Perceived susceptibility/perceived threat

Perceived threat of the disease included perceived susceptibility of TB for an HCW to develop TB. Perceived susceptibility is influence by the demographic variable of the HCWs such as age, gender, job status and their job duration and Secondly perceived susceptibility also greatly influence and determine by the healthcare workers structural variables such as their knowledge, attitude and practice. Therefore, it is important to understand their level of KAP which also directly reflects their perceived susceptibility on TB disease.

2.5 The Effect of Health Education on Rates of Infection

Literature has shown that education is one of the leading factors and important determinants concerning impact on rates of infections. One study conducted in a London hospital focused on an enhanced infection control programme. The programme was a combination of health education and several other strategies and findings showed a significant reduction in the proportion of patients acquiring methicillin-resistant Staphylococcus aureus (MRSA) (Schelenz et al., 2005). However, it is difficult to identify whether health education alone was the main factor in the significant reduction of MRSA infections.

Another intervention study by Lee et al. (2009) assessed the effectiveness of a health education programme to reduce MRSA infection. The programme consisted of lectures and demonstration on proper hand washing. The outcome of the programme at three months showed a significant reduction in MRSA infection rate (Lee et al., 2009). However, it did not have any impact on hand hygiene practice, and there was no follow-up to assess the long-term impact of the programme.

Similarly, a study conducted in the United States evaluated the impact of a comprehensive programme that included health education and other methods of intervention on infectious disease in long-term care facilities (Markris et al., 2002). Data were collected pre- and post-intervention and findings showed infection rates reduced significantly at the intervention site, whereas infection rates increased at control sites (Markris et al., 2002). However, it is unclear from the study whether there was a direct link between health education and infection rates.

Rosenthal et al. (2003) assessed the impact of interventions on intravenous device-related bacteraemia in Argentina. Their results showed that there was a significant reduction in infection following the health education programme; however, the long-term effects of the programme are unknown (Rosenthal et al., 2003).

Further, Aragon et al. (2005) reported that antibiotic-resistant infection rates significantly reduced following a health education intervention programme after one year. The researcher also noted that compliance with hand hygiene significantly improved (Aragon et al., 2005). Meanwhile, Coopersmith et al. (2002) produced similar findings with a health education programme by introducing self-study modules to prevent and reduce primary bloodstream infections. The research study showed infection rates reduced significantly after the introduction of the intervention programme (Coopersmith et al., 2002). However, it was unclear whether there was any adjustment within the methodology of the study or any other factors that could influence the bloodstream infection rates and no long-term effects were documented in the study.

Lastly, Won et al. (2004) investigated an intervention programme with a combination of health education and financial incentives that resulted in hand hygiene compliance among HCWs. Similarly, Berg et al. (1995) showed a significant reduction in pneumonia cases among HCWs after a health education programme. The focus of many of these studies reported that health education increases knowledge, which in turn improves practice and leads to reduced levels of infection. However, the findings of a research study by Santana et al. (2008) showed that despite an improvement in knowledge after a health education programme among HCWs, there was no significant reduction in catheter-related bloodstream infections cases in intensive care units. Therefore, based on this study, findings indicated that improvements in knowledge do not necessarily lead to reduction in infection rates. This finding was supported by Roberts et al. (2009) who emphasised that health education alone did not contribute to a significant reduction in infection rates compared with a combination of health education and another intervention programme among HCWs.

2.6 The Role of Education in Improving Practice

Based on the literature review, health education has the potential to improve infection control practices and compliance of hand hygiene practices, which contributes to a reduction in infection rates (Fendler et al., 2002; Ryan et al., 2001). Colombo et al. (2002) proved that hand hygiene compliance could be improved with target group teaching. Meanwhile, Lam et al. (2004) improved handwashing and reduced infection rates, which were sustained for 12 months after introducing a health education intervention programme. In contrast, Larson et al. (1997) found that despite improvements in infection control practice following multiple interventions, including a health education programme, the practice had returned to the initial baseline level by the 2-month follow-up stage.

2.7 Associations Between Job Status and KAP on TB Prevention among HCWs in Malaysia

Knowledge is defined as facts, information, and skills acquired through experience or education. Knowledge is powerful and essential in educating HCWs on disease prevention, especially communicable diseases. Knowledge is an essential step in TB prevention and disease control, especially among HCWs (Al-Maniri & Abdullah, 2008). A well-equipped training programme is required for HCWs to manage and treat TB effectively (Berger, 2006). KAP-style studies are used to establish baseline information or measure the effectiveness of particular intervention-related changes in an individual's related thoughts, skills, and understanding. Studies have found that knowledge on TB among HCWs was poor regarding both diagnosis and treatment (Jackson, 2005). LoBue and Moser (2001) noted that there was inadequate understanding of treatment and management of TB disease despite TB-related health education training. However, other studies suggested that TB knowledge improved significantly after health education training (Nshuti & Neuhauser, 2001). While the impact of a once-off health

education training programme can be inconsistent, there was evidence from other studies that continuous training and supervision can improve TB knowledge and skills among HCWs (Al-Maniri & Abdullah, 2008).

Several researchers have conducted KAP surveys for TB and their findings supported the need for HCWs to increase their knowledge and competence in the management of TB cases. Therefore, international guidelines were established based on these findings to assist TB control efforts (WHO, 2008). In global studies, the notification rate of TB incidence among HCWs was reported higher than in the general population (Joshi & Reingold, 2006). Currently, Malaysia is also facing a similar situation, and this is one of the largest threats to HCWs.

The definition of HCWs according to MOH Malaysia is a group of people who work in healthcare facilities. HCWs include nurses, medical assistants, health attendants, physicians, nursing and medical students, laboratory workers, dental workers, and others. A recent MOH annual report showed a significant increase in the incidence of TB among HCWs. Thirty-two HCWs were diagnosed with TB in the year 2002. However, the numbers have increased significantly to 264 HCWs diagnosed with TB in the year 2016.

A study conducted at the University Malaya Medical Centre (UMMC) in Petaling Jaya showed that the level of TB exposure is directly correlated with the occupational risk of HCWs (Tan & Kamarulzaman, 2009). The prevalence of Latent Tuberculosis Infection (LTBI) among HCWs at hospitals in Selangor and Klang Valley as reported by Rafiza et al. (2011) was 10.6%. Risk factors of TB among HCWs in Malaysia include male, employment duration (11 years or more), age 35 and above, a history of contact with active TB patients, and history working as a nurse (Rafiza et al., 2011). Job duration and incorrect technique of wearing personal protective equipment (PPE) (mainly respiratory protection during high-risk procedures) have been noted as the leading risk factors for TB

after controlling for other confounders, such as age, gender, and history of contact with active TB patients (Baussano & Nunn, 2011).

CHAPTER 3: ASSOCIATIONS BETWEEN JOB STATUS AND KAP ON TB PREVENTION AMONG HCWs IN MALAYSIA

3.1 Introduction

TB is a major occupational hazard for HCWs worldwide. (WHO, 2016) The transmission of Mycobacterium tuberculosis bacteria occurs through infected droplets aerosolized by patients with active pulmonary TB. The transmission risk to HCWs is highest when patients have unrecognized TB or are receiving inappropriate treatment. (Banda, 2014). However, many other factors influence the risk of transmission and progression to active disease, including healthcare setting, occupational category, individual susceptibility/immune status, and the adequacy of TB infection control and prevention (IC) measures which includes knowledge, attitude and practice on the disease.

The assessment of health workers' current knowledge about TB provides as a baseline information and as a basis for developing a program and monitoring future progress in implementation. The World Health Organization (WHO) had set the 2020 milestones of the End TB Strategy, 35% reduction in the absolute number of TB deaths and 20% reduction in the TB incidence rate, compared with levels in 2015 (WHO, 2016). WHO stressed the importance of knowledge, attitude and practice of TB caretakers to ascertain success in TB control (WHO, 2016)

Definition of healthcare workers according to Ministry of Health Malaysia (MOH) is a group of people who work in healthcare facilities. Healthcare workers include nurses, medical assistant, health attendant, physicians, nursing and medical students, laboratory workers, dental workers and others. (MOH, 2012).

3.2 Literature Review

Studies from various settings have indicated that many factors, including working environment, type of health facilities, public or private sector, and years of experience influence the level of KAP on TB. Minnery (2013) conducted a study in Lima, Peru among healthcare workers concerning knowledge and attitude towards TB (n = 301) and found major knowledge gaps in both the treatment and diagnosis of TB. Most of the participants (99.2%) agreed that continuous and periodic training was essential to improve TB control and prevention (Minnery, 2013). Additionally, a KAP assessment concerning TB and the Revised National TB Control Program (RNTCP) was conducted among private and government practitioners in district Gwalior, India, in 2011 (n = 200), which showed that there was a significant gap of knowledge of TB and the RNTCP among practitioners in both private and government sectors. Results also indicated a higher mean score of knowledge related to TB and RNTCP among government practitioners compared with private practitioners and a strong positive attitude towards RNTCP training.

Similarly, a cross-sectional KAP study conducted in Bangkok, Thailand in 2013 (n = 212) with healthcare providers showed that more than half of the participants (56.13%) had a good level of TB knowledge and their knowledge levels were significantly associated with participating in TB health education training and their job status. The research findings showed that 56% of participants had positive attitudes towards TB and based on subcategories, the majority (66.98%) had positive attitudes towards providing TB services. However, 60% of participants showed a negative attitude towards TB patients. Similar findings from a study conducted in New Zealand showed that some HCWs had positive attitudes towards their TB patients and enjoyed working alongside them (Al-Maniri, Al-Rawas, Al-Ajmi, & De Costa, 2008). In contrast, Holtz and Lancester (2006) found that HCWs in South Africa were not supportive towards TB

patients and this led to stigmatisation, which was associated with high default rate in TB treatment.

Regarding TB practice, many healthcare providers in Sagnarigu districts were not delivering practice according to the National TB Program (NTP) guidelines. Job duration, TB training attendance, and age were found to be factors related to practice in the delivery of TB care. For example, in terms of practice regarding sputum collection, almost all medical technologists/laboratory technicians (93.88%) informed patients how to collect sputum for diagnosis. If the returned sputum sample was not adequate for diagnosis, 89.36% of providers would ask the patient to collect a new sputum sample (Lertkanokkun, 2013).

A knowledge and infection control study conducted in Russia in 2010 (n = 96) among HCWs showed that the overall scores on TB knowledge were low, especially supporting staff and laboratory technicians (Woith, Volchenkov, & Larson, 2010). The researchers identified the main areas of knowledge deficit were preventive measures and infection control and that the knowledge level among HCWs could influence the prevalence of nosocomial TB infection (Woith et al., 2010).

In Jamaica, one study (n = 245) showed that the majority of HCWs have moderate knowledge on TB, whereas only 40% of participants had good knowledge of TB (White, 2011). Higher education levels and number of years of employment at public healthcare facilities were identified as factors associated with good knowledge on TB among HCWs (White, 2011). More than half of the participants agreed that TB was a major public health threat to Jamaica (White, 2011).

A study conducted in Ujjain city of India in 2012 (n = 110) with a provider that followed the WHO's DOTS strategy showed that 56.9% of the HCWs had good knowledge on TB and this was significantly higher in men (72.4%; p = 0.04) and participants aged less than 30 years (79.5%; p = 0.02) (Jain, Chakole, & Pawaiya, 2012).

All participants could identify cough for more than two weeks duration as the symptom of TB. Knowledge of case definitions of relapse, default, and failure of treatment were assessed and participants answered these correctly 45.5%, 34.3%, and 20.6%, respectively (Jain et al., 2012). If the patient did not come to take medicine at their scheduled time, 80.4% providers would visit the patient's home, 82.4% asked for two sputum examinations, and 57.8% would refer patients to a specialist at TB hospital (Jain et al., 2012). Overall, knowledge of TB disease among DOTS providers was not satisfactory; however, knowledge was good in those with higher qualifications (Jain et al., 2012). Moreover, 36.3% had good attitude and practice and 77.5% were in favour of being tested for TB (Jain et al., 2012). At the end of the intensive phase, 70.5% agreed to be tested and/or repeat sputum microscopy (Jain et al., 2012).

In Peru, Kiefer and Shao (2009) assessed the knowledge and attitudes of HCWs, mainly nurses and doctors. Their findings showed there were knowledge gaps in identifying the high-risk group among patients, monitoring for treatment outcome, and sequelae of treatment failure (62.9%) (Kiefer & Shao, 2009). HCWs agreed that alternative or traditional medicine for TB made health outcomes worse and highlighted that social and cultural factors play a major role in treatment barriers (67.6%) (Kiefer & Shao, 2009). More than half (62%) of the HCWs believed that community awareness on TB was limited and the majority (98.6%) agreed that health education is an essential component of TB prevention and management (Kiefer & Shao, 2009). Almost 60% of healthcare professionals agreed that failure in TB treatment in Peru was due to treatment error (Kiefer & Shao, 2009).

Research findings from a study conducted in Pakistan in 2009 (n = 22) indicated that there was lack of knowledge among general practitioners concerning TB diagnosis and treatment (Ahmed, Fatmi, & Ali, 2009). The researchers also noted that only 14% of the general practioners advised for sputum microscopy investigation, and more than 40%

of general practitioners failed to prescribe TB treatment regime according to the DOTS strategy (Ahmed, et al., 2009). The practice of general practitioners (GPs) on TB management reported that the majority (86%), failed to advise the patient for sputum microscopy investigation for treatment or during follow-up of TB patients at the end of their second, fifth, and seventh month of treatment (Ahmed et al., 2009). Once the patient completed the treatment, none of the GPs evaluated or recorded the status of the treatment outcome as completed treatment and cured or treatment failure (Ahmed et al., 2009). Almost 43% obtained TB information through continuous medical education, followed by TB updates training through a non-governmental organisation training programme (32%) and from professional colleagues (27%) (Ahmed et al., 2009).

Research conducted in Oman found that GPs mainly from private sectors appear to have a low index of suspicion regarding diagnosing patients with TB (Vandan, Ali, Prasad, Kuroiwa, 2009). Specifically, GPs have poor knowledge of TB in the areas of screening, diagnosis, treatment, and monitoring (Vandan et al., 2009).

A cross-sectional survey conducted in Davangere city of India in 2010 with 181 allopathic and 143 non-allopathic GPs showed that the majority have opted for some form of defaulter retrieval, with 48.6% of them stating that they would send a message through an acquaintance and the rest would either make a phone call or write a letter (Jayaprakashm, 2010). All participants mentioned that they give health education regarding completion and regularity of treatment, but 18% of the practitioners do not create any awareness because awareness about the side effects of the drug might lead to discontinuation of drugs and affect the treatment compliance (Jayaprakashm, 2010). Although 43.8% of the practitioners reported that health education should be given for improving treatment compliance, 33.7% indicated they would refer patients to the district TB centre, and 21% would refer to a specialist (Jayaprakashm, 2010).

In rural Iraq, almost 40% of the 500 HCWs sampled were able to provide proper management on suspected TB cases (Hashim, Al Kubaisy, & Al Dulayme, 2003). In contrast, TB patient management competency was low among HCWs in basic health facilities in Vietnam (Hoa & Thorson, 2005).

Findings from a Belgian research study on TB prevention practices showed that only 24% of HCWs wore proper respiratory facemasks, which are able to filter particles that are 1-micron in size (Ronveaux & Jans, 1997). The researchers also noted insufficient preventive measures taken to prevent transmission of TB among HCWs (Ronveaux & Jans, 1997). Meanwhile, a study conducted in Britain on mechanisms and management of MDR-TB showed that recent outbreaks were due to poor clinical practices (Havward, Herrman, & Griffin, 1995).

Another cross-sectional study on KAP among HCWs in South Africa reported that most of the participants were able to recognise that pulmonary TB is an infectious disease and 117 (90.7%) participants agreed that TB was spread through droplets and airborne transmission (Bhebhe, 2014). A total of 69 (53.5%) HCWs considered fever to be a symptom of TB and most of the participants (92.4%) agreed that sputum examination was a major diagnostic tool, but only 29 (22.0%) were aware of the appropriate place for sputum collection (Bhebhe, 2014). All participants agreed that they were willing to change their attitude and practices towards TB infection prevention and control methods, with 93.0% of them reporting positive attitudes (Bhebhe, 2014). Forty-seven (36.4%) of the respondents self-reported inappropriate practices on infection prevention and control methods; however, 92 (71.3%) reported that they used respiratory protection masks and more than half (54.4%) used the N95 respirator (Bhebhe, 2014).

A cross-sectional study conducted in Nigeria in 2013 (n = 52) found that there were knowledge gaps present concerning TB disease and treatment, but mainly in infection control (Ukwaja & Alobu, 2013). In this study, 48% of participants were doctors

and nurses, however, only 27% demonstrated good knowledge scores (Ukwaja & Alobu, 2013). Alternatively, a study conducted in Maseru, Lesotho in 2011 (n = 130) on KAP of HCWs about prevention and control of MDR-TB showed that 47.3% of respondents had good knowledge about MDR-TB (David, 2011). A total of 85.5% of respondents had negative attitude towards patients with MDR-TB (David, 2011). The study findings showed no significant difference concerning age, but found that gender was significant in that female participants (87.9%) showed a more negative attitude than males (81.8%) (David, 2011). Moreover, participants with a greater job duration had a more negative attitude (David, 2011). Most participants (61.5%) owned a copy of the MDR-TB prevention and management guidelines and almost all (96%) agreed that the guideline was used to assist them in managing MDR-TB correctly (David, 2011). Meanwhile, 82.7% of participants responded that they used an N95 respiratory mask and participants with good knowledge on MDR-TB wore a respiratory mask more frequently compared with those with poor knowledge (David, 2011). Interestingly, participants with negative attitude wore respiratory masks more frequently compared with those with a positive attitude (David, 2011).

Another study conducted in South Africa reported that inadequate training of HCWs leads to poor knowledge on MDR-TB, mainly concerning transmission and management (Naidoo & Taylor, 2017). Similarly, Loveday and Thomson (2008) showed that an increase in MDR-TB cases was due to inadequate knowledge by clinicians, mainly on effective TB diagnosis and treatment. An additional cross-sectional study conducted in South Africa in 2009 (n = 499) among HCWs concerning evaluations of infection control in MDR-TB showed that attending communicable disease control training in the past 12 months was associated with significantly higher knowledge scores (Farley, 2012).

Research from an institution in the Amhara Region of Ethiopia in 2012 (n = 112) with GPs showed that 44 (39.3%) of GPs did not have satisfactory knowledge of the

DOTS strategy (Yimer, Carol, & Gunnar, 2012). The research findings also showed those who attended DOTS training during the two years prior to the survey were more likely to have satisfactory knowledge compared with those who did not receive training (Yimer et al, 2012). A total of 88 (78.6%) participants correctly indicated that acid-fast bacilli (AFB) sputum microscopy was the best monitoring tool and among those providing smear microscopy as a tool for treatment monitoring, the correct frequency of treatment monitoring was mentioned by 44 (50%) of the respondents (Yimer et al., 2012). The other 44 (50%) indicated different schedules that were not according to the recommendations of NTLCP guidelines, 83 (74%) of the respondents used NTLCP manuals as their main source of information on TB control programmes (Yimer et al., 2012).

In Addis Ababa, 36.1% of HCWs (n = 590) demonstrated poor knowledge and 51.7% had unsatisfactory practice scores on TB infection control (Demissie, Aderaw & Tilahun, 2015). The researchers noted that participants with job duration of more than six years demonstrated good knowledge and participants who worked in TB clinics or had previously attended TB-related training demonstrated good practice in TB infection control (Demissie et al., 2015). An institution-based study conducted in Northwest Ethiopia in 2010 with health professionals (n = 313) showed that 74.4% were found to have good knowledge and 63.2% good practice on TB infection control (Temesgen & Demissie, 2011). Further, health education training was found to be a predictor of TB infection control knowledge and this knowledge was a strong predictor of good TB infection control practice (Temesgen & Demissie, 2011). A similar study in Addis Ababa with HCWs about hand hygiene and TB infection control measures showed that the large majority of HCWs (71%) were concerned about acquiring TB while at work (Tenna, Stenehjem, & Margoles, 2013).

3.3 Methodology

3.3.1 Study Design

This was a cross-sectional study to determine the association between job status and KAP on TB prevention among HCWs in Malaysia.

The cross-sectional study was determined the best study design because it is an efficient study design to find the association between job status and KAP on TB prevention at a particular point in time. Additionally, the study can be done relatively quickly and inexpensively.

3.3.2 Sampling frame

The study applied to selected health clinics and hospitals in Malaysia. In total, 233,715 HCWs were employed by the MOH in 2016. A total of 57,880 were nurses, 30,923 were doctors, 28,268 were health attendants, and 10,986 were medical assistants.

Currently, there are 936 health clinics in Malaysia, which include 579 rural health clinics and 357 urban health clinics. Regarding hospitals, there are 14 state hospitals, 24 major specialist hospitals, 18 minor specialist hospitals, and 75 non-specialist hospitals. This study was conducted from February 2016–August 2016.

All HCWs who had been working in MOH hospitals and health clinics were the source population. The sample for this study consisted of doctors, nurses, medical assistants, and health attendants. These four groups of job statuses were chosen based on the highest four job statuses diagnosed with TB among HCWs in Malaysia from 2011 to 2015. Doctors, nurses, medical assistants, and health attendants employed and currently working in hospitals and health clinics under the MOH were selected as the sample for this study.

The sampling method was convenience sampling from 11 states in Malaysia; however, the sample was chosen by a respective State Health Department field representative based on inclusion criteria to participate in this study. Convenience sample is simply one where the units that are selected for inclusion in the sample are the easiest to access.

This is in stark contrast to probability sampling techniques, where the selection of units is made randomly. There are few advantages of selecting convenience sampling. Firstly, convenience sampling is very easy to carry out with few rules governing how the sample should be collected. Secondly, the relative cost and time required to carry out a convenience sample are small in comparison to probability sampling techniques. This enables researcher to achieve the sample size you want in a relatively fast and inexpensive way. Thirdly, this method assisted the researcher in gathering useful data and information that would not have been possible using probability sampling techniques, which require more formal access to all hospitals and health clinics in 11 states in Malaysia to lists of populations.

3.3.3 Sample size and sample technique

The sample size was determined using the following formula n = Z square p (1-p)/d square; where, Z = value at a specified confidence level, P = approximate proportion of the event in the population and d = acceptable margin of error in estimating the true population proportion of Malaysian HCWs with adequate knowledge on occupational exposure to TB. Therefore, if the true population proportion of Malaysian HCWs with adequate knowledge is 35%, given a 1.96 value of the 95% confidence interval and 0.04 as an acceptable margin of error and a 40% non-response, the minimum sample size required for the study was 1,600. Recruitment was conducted utilising convenience sampling from different states and facilities, e.g., hospital and health clinics and job categories.

3.3.4 Participants

Based on Tuberculosis Information System database by Ministry of Health Malaysia showed that 91% of Tuberculosis cases among healthcare workers are from government

healthcare workers compared to 9% from private healthcare workers. Therefore, Government healthcare workers were selected in this study. (M.O.H, 2016)

Besides that, Doctors, Nurses, Medical assistant and Health attendant were the top four job categories that has the highest Tuberculosis cases among healthcare workers in Malaysia, therefore, these four job categories were included in this study. (M.O.H, 2016)

Inclusion criteria:

- Doctors, nurses, medical assistants, and health attendants who were currently working in hospitals or health clinics employed by the MOH.
- Job duration of more than one year.

Exclusion criteria:

- Previous history of TB.
- Job duration of less than one year.

3.3.5 Ethical approval

Ethical approval for this study was obtained from the Medical Research and Ethics Committee of Ministry of Health Malaysia (MOH) (Reference Number: NMRR-15-913-24992 (Appendix H). The permission to conduct the study was also obtained from Disease Control Unit, Ministry of Health Malaysia. (Appendix F). Informed consent was also obtained from all participants, and ethical principles were preserved with strict adherence to confidentiality (Appendix C, D and E).

3.3.6 Data collection

3.3.6.1 Instrument.

A validated, structured 87-item questionnaire was employed as the data collection instrument.

3.3.6.2 Questionnaire

The questionnaire was prepared in both English and Malay using simple language easily understood by all category respondents. This questionnaire was pre-tested, and a reliability test was preformed prior to this study among a group of respondents similar to the study sample. The survey consisted of 87 items: knowledge (55 items), attitude (15 items), and practice (17 items). The reliability analysis showed that 39 out of 87 items of the KAP questionnaire sufficiently exhibited a measure of high internal consistency as their Cronbach's alpha values exceeded 0.7. The KAP domains showed good internal consistency as their Cronbach's alpha values were approximately 0.8. These findings provided evidence to support the reliability of the KAP questionnaire as an instrument useful for determining the level of KAP concerning TB among HCWs.

Accordingly, the questionnaire was divided into six sections as follows:

Section A: Sociodemographic factors and general information

The respondents' sociodemographic variables were collected, including age, gender, the highest level of education, job status, workplace, and job duration. Respondents were asked whether they knew or heard of TB and if so, which sources they used to obtain information on TB. They were also asked whether they or any of their close contacts, such as neighbours or relatives, had a history of TB. Last, they were asked if their family or close contacts would visit them in their home if they were diagnosed with TB.

Section B: Knowledge of TB

The knowledge section contained 15 questions and was divided into seven sections: general information, signs, symptoms, risk factors, investigation, treatment, and preventive control measures. Answers were established as "Yes", "No", or "Don't Know".

General awareness on TB was assessed by enquiry general information, symptoms, mode of spread and transmission, risk factors, diagnostic tests, treatment, and prevention. The questions on knowledge of TB employed simple lay terms for easy understanding. A maximum score of two was given to a correct answer, a score of one given for "Don't Know", and score of zero for the wrong answer. Total possible scores ranged from 0–110 points. The examples of questions in knowledge sections are i) TB can spread from an infected individual by talking? ii) smoking is a risk factor of Tuberculosis disease?

Section C: Attitudes towards TB

The attitudes of the respondents towards TB were assessed by an enquiry as to how the respondent views TB patients. Attitudes were assessed based on attitude as HCWs towards TB and attitude towards TB patients. This domain also included items on TB that consisted of statements concerning attitude (respondents' reaction) towards the disease prevention as a HCW. The 15 items in the attitude domain were scored on a five-point Likert scale, which consisted of "Strongly Agree", "Agree", "Not Sure", "Do Not Agree", and "Strongly Disagree". A maximum score of five was given to the most positive/tolerant response, whereas a minimum score of one point was given for the most negative response (Jain et al., 2010). In identifying positive/negative attitudes, the five-point Likert scale was collapsed into two categories: agreement (Strongly Agree, Agree) versus disagreement (Not Sure, Do Not Agree, Strongly Disagree) (Kiefer et al., 2009). Total possible scores ranged from 15–75 points. The examples of questions are i) TB patients should not attend social functions (birthday, new year) ii) TB disease can affect Breast feeding?

Section D: Practices towards TB patients and preventive measures

Respondents were asked about the course of action they would take in their workplace, personal prevention measures taken during working with TB patients, availability, and usage of other preventive measures in their workplace. This domain

consisted of 17 items scored on a five-point Likert scale with "Always", "Often", "Sometimes", "Seldom", and "Never" being the choices offered. A maximum score of five was given to the correct answer, whereas a minimum score of one was awarded for the wrong answer. The total possible score ranged from 17–85 points. The example of questions is i) Do you wear gloves when any possible contact with potential infectious material exist? ii) Do you provide mask to TB patient having cough?

3.3.7 Recruitment process

The researcher obtained approval from the MOH to conduct this study within their facilities through the National Medical Research Register (NMRR). Copies of the letters of approval and permission to conduct the study were provided to Dr Rozlan Bin Ishak, Deputy Director Infection Control (PTB) MOH. Approval was obtained to conduct this study in all healthcare facilities in Malaysia. Subsequently, the researcher approached each state health director in all states to explain and obtain approval to conduct this study in their respective state. Approval was obtained from 11 states in Malaysia to conduct this study.

Field representatives were selected from each state to assist in the data collection. The OHU, TB unit, and quality unit in each state assisted in data collection for this study. These representatives were trained on details of this study, which included rationale, background, methodology protocol, and research instruments (informed consent, participant information sheet, and questionnaire).

The researcher conversed with field representatives at each of the identified facilities and field representatives approached the HCWs based on the inclusion criteria. HCWs were invited to participate and the participant information sheet was reviewed. Eligibility was determined by clarifying the various categories of workers and explaining the inclusion criteria to them. After reviewing the participant information sheet with the HCW and verifying eligibility, if participants were interested in participating in the study,

written consent was obtained. The participant was asked to complete the self-administered questionnaire in the presence of the researcher or field representative. Once completed, questionnaires were collected. HCWs who refused to participate were simply thanked for their time without any further pressure to change their mind or explain their refusal.

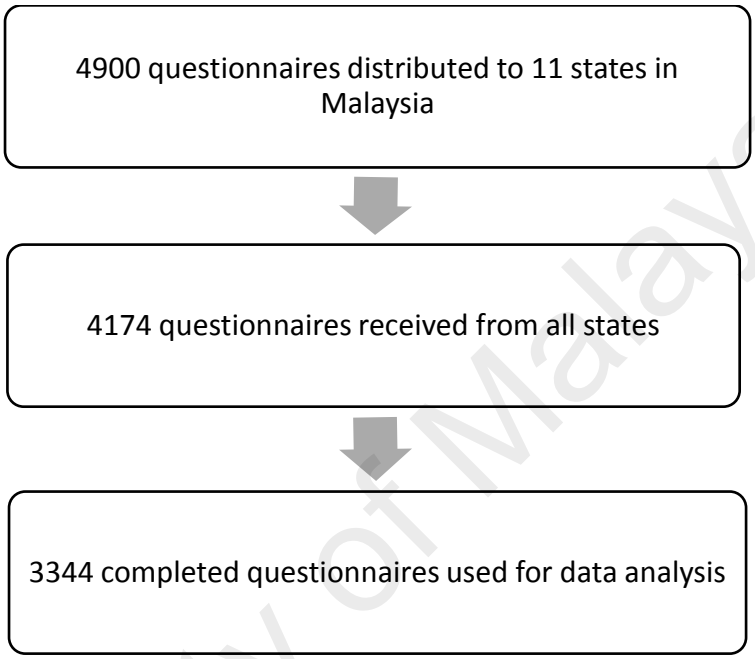


Figure 3.1: Flowchart of questionnaire distribution

3.3.8 Data cleaning

The questionnaire was pre-coded for entry and analysed using the Statistics Package for Social Sciences (SPSS) Statistics software (version 21). Check codes were included in the database to minimise data entry errors and data cleaning was done to ensure data consistency.

Based on sample size calculation, we required 1200 participants in this study. However, 4900 questionnaires distributed along 11 states in Malaysia and 4174 questionnaire received. During data cleaning, we excluded all questionnaires which was not complete. A total of 830 questionnaires were excluded due to missing data. Missing data questionnaires were not analysed due to sufficient available completed questionnaires (3344) from 1200 minimum required participants in this study.

3.3.9 Data analysis

All data were summarised and analysed using SPSS (version 21) and Stata statistical software. Raw data were cleaned and checked for consistency and accuracy by examining the frequencies for each variable (LoBiondo-Wood & Haber, 2002; Polit & Beck, 2004), and by using the explore procedure in SPSS for Windows. Non-responses were treated as missing values and therefore excluded from the analyses. Several types of statistical analyses were performed to determine the relationship between the variables. Firstly, normal distribution was tested. Descriptive statistics summarised and described the data by employing the techniques of frequency distribution, mean (M) or Median (if the data were skewed or abnormally distributed), and standard deviation (SD) or range to gather the average of the sample characteristics, to examine the accuracy of the data set, and to adjust the data to meet the requirements of inferential statistics (LoBiondo-Wood & Haber, 2002; Polit & Beck, 2004).

Univariate, bivariate, and multivariate analyses were performed. The assumptions underlying the statistical methods were checked before proceeding with statistical analyses. Statistical significance was reported at the conventional p-value of equal to or less than .05 level (two-tailed) with 95% confidence interval (CI).

3.3.9.1 Univariate analysis

Descriptive analyses were used to examine demographic variables, including age, gender, education level, job duration, workplace, family history of TB, friends with TB, and history of visiting family/friends with TB. The mean and SD for continuous variables (age, job duration) and the count and percentages for the dichotomous or categorical variables (gender, education level, workplace, family history of TB, friends with TB, history of visiting family/friends with TB) were calculated.

3.3.9.2 Multivariate analysis

The total KAP scores were expressed as means and SD. All scores were converted into percentage scores. Later, percentage scores were converted into three categories based on Blooms criteria: high (≥80%), moderate (61%–79%), and low (≤60%). Blooms criteria was originally used in academic scoring system to differentiate between 3 categories which consist of high with achievement of 80.0%–100.0% of total scores, moderate category with achievement of 60.0%–79.0% of total scores and low categories with achievement of ≤59.0% of total scores. The original Bloom's criteria or Bloom's cut-off points, 80.0%–100.0%, 60.0%–79.0%, and ≤59.0%, were adapted and modified from the KAP study conducted on dengue fever prevention among the people of Male', Maldives and Bangkok in 2007 (Nahida A., 2007). They were used to classify KAP into three levels which is high, moderate and low. The potential influencing factors on practices were examined by using univariable and multivariable analyses. For the univariable analysis, simple linear regression was applied to identify significant variables. Using the variables that had the p-value ≤ 0.05, biologically plausible, and under main interests of the study, a forward general linear regression model was constructed to obtain a preliminary main effect model. After the variable selection, interaction and multicollinearity were checked to obtain the preliminary final model. The final model was obtained after checking model assumptions (linearity, independence, normality, equal variances, and fit of independent numerical variables). The results were presented by appropriate tabulations based on the determined variables, crude or adjusted regression coefficient with 95% CI and its corresponding p-values. The level of significance was set at 0.05.

3.4 Results

3.4.1 Sample characteristics

Table 3.1 shows the characteristics of survey respondents by job categories. The overall mean±SD age and job duration of the 3,344 participants were 34.6±8.6 and 10±8.2

years, respectively. The proportion of females, those with at least one degree, and those who were currently working in the hospital was 71.8%, 17.7%, and 42.4%, respectively. Based on statistical analysis, there was significant difference in age, job duration, gender, education level, and workplace among all job statuses.

Doctors were more likely to be male, youngest among all other job categories with a mean age of 31.0±0.2, have a high level of education (all have at least one-degree qualification), and have the shortest job duration compared with other job categories. The majority of nurses were female with a mean age of 35.0±0.2, had a moderate level of education (the majority held STPM/Diploma qualification), and were almost equally distributed between clinic and hospital settings. The majority of medical assistants were male with a mean age of 33.7±0.3, had a moderate level of education (the majority held STPM/Diploma qualification), and the majority worked in a clinic setting. The majority of health attendants were female, they were older with a mean age of 38.1±0.4, had a lower education level (the majority held high school qualification (PMR/SPM)), the majority worked in a clinic setting, and they had the longest job duration compared with other job categories.

Overall, most of the respondents did not have a family history of TB or history of TB among friends with 82.3% and 69.3%, respectively. Hence, most had no history of visiting friends or family with TB. Indeed, only 10% of respondents indicated visiting family or friends with TB. Concerning KAP and TB prevention, it was noted that only half (50.3%) answered that they have sufficient KAP on TB prevention and the rest indicated they were unsure or had insufficient KAP on TB prevention. Based on job categories, the majority (66.5%) of doctors responded they have sufficient KAP on TB prevention, whereas only 32% of health attendants responded they have sufficient KAP on TB prevention. Nurses and medical assistants were almost similar regarding sufficient KAP on TB prevention with 49.5% and 51.7%, respectively.

Table 3.1: Characteristics of survey respondents by job categories.

Covariates	Overall	Doctor	Nurses	Medical Assistant	Health Attendant	P-value
	n (%) (N = 3344)	n (%) (N = 564)	n (%) (N = 1706)	n (%) (N = 602)	n (%) (N = 472)	
Age*, years	34.6 ±8.6	31 ±0.2	35 ±0.21	33.7 ±0.33	38.1 ±0.43	<0.001
Gender						<0.001
Male	942 (28.2)	219 (38.8)	77 (4.5)	468 (77.7)	178 (37.7)	
Female	2402 (71.8)	345 (61.2)	1629 (95.5)	134 (22.3)	294 (62.3)	
Education level						<0.001
PMR/SPM	922 (29.6)	0 (0)	513 (31)	36 (6)	369 (78.2)	
STPM/Diploma	1830 (54.7)	0 (0)	1144 (67.1)	520 (86.4)	100 (21.2)	
Degree	577 (17.3)	579 (97.9)	48 (2.8)	44 (7.3)	3 (0.6)	
Master/PhD	15 (0.4)	12 (2.1)	2 (0.1)	1 (0.3)	0 (0)	
Job duration*, years	10 ±8.2	5.2 ±0.18	11.02 ±0.2	9.47 ±0.32	12.63 ±0.44	<0.001
Workplace						<0.001
Hospital	1418 (42.4)	219 (38.8)	803 (47.1)	224 (37.2)	172 (36.4)	
Clinic	1925 (57.6)	345 (61.2)	902 (52.9)	378 (62.8)	300 (63.6)	
Family history of TB						0.115
Yes	446 (13.3)	65 (11.5)	235 (13.8)	96 (15.9)	50 (10.6)	
No	2753 (82.3)	472 (83.7)	1405 (82.4)	478 (79.4)	398 (84.3)	
Don’t Know	145 (4.3)	27 (4.8)	66 (3.9)	28 (4.7)	24 (5.1)	
Have friend with TB						<0.001
Yes	744 (22.2)	131 (23.2)	367 (21.5)	158 (26.2)	88 (18.6)	

Table 3.1, continued

No	2319 (69.3)	398 (70.6)	1186 (69.5)	407 (67.6)	328 (69.5)	
Don't Know	281 (8.4)	35 (6.2)	153 (9)	37(6.1)	56 (11.9)	
History of visiting family/friends with TB						<0.001
Yes	325 (9.7)	60 (10.6)	145 (8.5)	81 (13.5)	39 (8.3)	
No	872 (41.6)	215 (38.1)	720 (42.2)	290 (48.2)	166 (35.2)	
Do not sure	1628 (48.7)	289 (51.2)	841 (49.3)	231 (38.4)	267 (56.6)	
Opinion on sufficient KAP						<0.001
Yes	1683 (50.3)	375 (66.5)	844 (49.5)	311 (51.7)	153 (32.4)	
No	872 (26.1)	91 (16.1)	484 (28.4)	141 (23.4)	156 (33.1)	
Do not sure	789 (23.6)	98 (17.4)	378 (22.2)	150 (24.9)	163 (34.5)	

* age and job duration summarised as mean±SD

Table 3.2 describes the source of information on TB by job categories. Overall, the major source of information for the study participants was obtained from professional colleagues, which encompassed 2,959 (88.5%), followed by booklets/leaflets comprising 2,583 (77.2%), and radio was the least common with 1,132 (33.9%). Based on job status, information on TB from professional colleagues was the highest choice source of information among nurses, health attendants, and medical assistants, whereas printed booklets/leaflets were the highest choices for the source of information among doctors. Information from professional colleague defined as participants obtain information of TB from their working colleagues or their seniors in their workplace.

In conclusion, it was noted that the source of information of choice among doctors, nurses, medical assistants, and health attendants were from their professional colleagues

and booklets or leaflets. Therefore, a training programme on TB should include this source of information to educate HCWs.

Table 3.2: Source of information on TB disease by job categories.

Source of information on TB	Overall	Doctors	Nurses	Medical Assistants	Health Attendants	P-value
	n (%)	n (%)	n (%)	n (%)	n (%)	
Friends, relative	1760 (52.6)	279 (49.5)	921 (54.0)	316 (52.5)	244 (51.7)	0.30
Professional colleague	2959 (88.5)	439 (77.8)	1590 (93.2)	525 (87.2)	405 (85.8)	<0.001
Newspaper	1696 (50.7)	237 (42.0)	932 (54.6)	297 (49.3)	230 (48.7)	<0.001
Radio	1132 (33.9)	143 (25.4)	665 (39.0)	181 (30.1)	143 (30.3)	<0.001
TV	1669 (49.9)	211 (37.4)	941 (55.2)	280 (46.3)	237 (50.2)	<0.001
Booklets, leaflets	2583 (77.2)	442 (78.4)	1359 (79.7)	469 (76.7)	320 (67.8)	<0.001
Total	11799	1751	6408	2068	1579	

***** Percentage within occupation category
* Respondents answered more than one source of information

3.4.2 Assessment of knowledge of TB

Table 3.3 describes the responses of the participants towards TB KAP. Knowledge was assessed by questions focusing on TB aetiology, signs, symptoms, transmission, risk factors, treatment, and management of TB disease and prevention. Each response was answered as "Yes", "No", and "Don't Know". The possible scoring range was between 0 and 110. Knowledge scores for individuals were calculated and summed up to give the total knowledge score after which the total knowledge score was converted into percentages. Based on Blooms criteria, participants' scores were divided into three categories, poor (<60%), moderate (60% to 80%), and high knowledge (>80 %).

Out of the 3,344 participants, 564 were doctors, 1,706 were nurses, 602 were medical assistants, and 472 were health attendants. Overall, respondents obtained the lowest score from transmission of TB questions with a total of 14.3±2.9 (70%) from a maximum score of 20 (100%). Meanwhile, respondents obtained the highest score in treatment for TB with 93%.

Based on knowledge scores by job status, the overall mean knowledge score was 88.0±6.6. Doctors had the highest total mean score in knowledge with 90.2±5.9, followed by nurses and medical assistants with a similar mean score of 88.0±6.4, and health attendants had the least mean score of 85.7±7. Based on statistical analysis, there was a significant difference (p value <0.05) in knowledge score by job status.

3.4.3 Assessment of attitude towards TB

Attitude towards TB was assessed with 17 questions based on two categories or domains, which were a general attitude towards TB and attitude as HCWs towards TB, as shown in Table 3.3. A score of 1 was given for “Strongly Agree”, a score of 2 given for “Agree”, a score of 3 for "Not Sure", 4 for “Disagree”, and 5 for “Strongly Disagree” for all the questions except questions 10d and 10e, which were reversed scored. The total possible score range was a minimum of 17 to a maximum of 85. Attitude scores for individuals were calculated and summed to obtain the total attitude score, then the total attitude score was converted into percentages. Based on Blooms criteria, participants scores were divided into negative (<60%), neutral (60% to 80%), and positive attitude (>80%).

Based on attitude scores by job status, the overall mean score for attitude was 57.4±8.0. Doctors had the highest total mean score in attitude with 60.4±8.1, followed by medical assistants with 58.0±8.1, nurses with 56.8±7.6, and health attendants with the lowest mean score of 54.8±7.9. Based on statistical analysis, there was a significant difference (p value <0.05) in attitude score by job status.

The majority of the respondents believed that they should avoid interacting with TB patients and fear transmission of TB infection when interacting with TB patients (62% and 59%, respectively). Additionally, more than half of the respondents stated that TB patients should avoid marriages and quit their jobs.

3.4.4 Assessment of practices towards TB

Practices on TB prevention were assessed by 15 questions. A score of 1 was given for "Never", a score of 2 given for "Rarely", a score of 3 for "Sometimes", a score of 4 for "Very Often" and score of 5 for "Always", except for question 3b whereby the scoring was reversed. A total score ranged from a maximum of 75 to a minimum of 15.

Overall, the mean score for practice on TB prevention among HCWs was 64.0±7.2. Based on job status, nurses had the highest mean score for practice with 65.0±6.6. Doctors, medical assistants, and health attendants had almost similar mean scores, which ranged from 62 to 64 marks. Based on statistical analysis, there was a significant difference (p value <0.05) in practice score by job status.

Table 3.3: Variation of KAP scores by job categories.

	Plausible range	Overall, Mean ±SD	Doctor, Mean ±SD	Nurse, Mean ±SD	Medical Assistant, Mean ±SD	Health Attendant, Mean ±SD	P-value
Sample size, N		**3,344**	**564**	**1,706**	**602**	**472**	
Knowledge							
Total	0-110	88.0 ±6.6	90.2 ±5.9	88.0 ±6.4	88.0 ±6.4	85.7 ±7	≤ 0.001
Introduction	0-16	13.9 ±1.1	14.2 ±2.0	13.9 ±1	13.9 ±1.2	13.5 ±1.4	≤ 0.001
Symptom	0-22	20.0 ±2.8	20.2 ±2.6	20.2 ±2.7	19.7 ±2.9	19.8 ±2.8	0.002
Transmission	0-20	14.3 ±2.9	15.1 ±2.7	14.2 ±2.8	14.5 ±3	13.4 ±3	≤0.001
Risk Factor	0-12	8.7 ±2.4	9.8 ±1.8	8.5 ±2.5	8.8 ±2.4	7.9 ±2.4	≤0.001
Testing Tb	0-6	4.1 ±0.5	4.2 ±0.5	4.0 ±0.3	4.1 ±0.4	4.1 ±0.6	≤0.001
Treatment	0-8	7.5 ±1.1	7.8 ±0.8	7.6 ±1.1	7.5 ±1.1	7.2 ±1.1	≤0.001
Prevention	0-14	10.9 ±2.9	10.5 ±3.0	10.9 ±2.8	10.9 ±3.0	11.0 ±2.8	0.006
Vaccination	0-12	8.6 ±1.9	8.6 ±1.9	8.5 ±1.8	8.7 ±1.7.0	8.6 ±2.0	0.297
Attitude							
Total	17-85	57.4 ±8	60.4 ±8.1	56.8 ±7.6	58.0 ±8.1	54.8 ±7.9	≤ 0.001
General Attitude	9-45	31.4 ±5.8	33.5 ±5.8	30.9 ±5.6	32.0 ±5.7	29.9 ±5.5	≤0.001
Healthcare	8-40	26.0 ±3.6	26.9 ±3.6	26.0 ±3.4	26.0 ±3.8	24.9 ±3.7	≤0.001
Practice							
Total	15-75	64.0 ±7.2	63.5 ±7.6	65.0 ±6.6	63.2 ±7.1	62.0 ±8.1	≤ 0.001
Personal practice	5-25	20.3 ±2.6	20.6 ±2.8	20.5 ±2.5	19.9 ±2.7	19.5 ±2.7	≤0.001
Work practice	4-20	17.9 ±2.8	17.2 ±3.3	18.5 ±2.4	17.6 ±2.8	17.4 ±3.3	≤0.001
Control measure practice	6-30	25.8 ±3.9	25.7 ±3.7	26.1 ±3.8	25.7 ±3.8	25.0 ±4.6	≤0.001

Table 3.4 shows the association between job status and KAP scores. Linear regression analysis was applied to evaluate the mean difference of KAP on TB prevention with KAP on TB prevention as the outcome variable. Firstly, the analysis explored the crude difference in mean score, and later considered the adjusted difference in mean score. This model adjusted for age, job duration, gender, workplace, and family history of TB.

Based on the crude difference in mean score, doctors had the highest knowledge mean score with 90.2. Nurses and medical assistants had similar mean score differences of 2.4 and 2.2, respectively. Meanwhile, health attendants had the lowest mean score at 4.6 points less than doctors. Based on attitude scores, doctors had the highest attitude mean score with 60.4. Meanwhile, health attendants had the lowest mean score at 5.6 points less than doctors. Statistical analysis shows there are significant differences (p value <0.05) in attitude mean scores among all job statuses.

The analysis of practice scores showed nurses had the highest practice mean score with 65.1 and health attendants had the lowest mean score with only 1.4 score difference. Meanwhile, doctors and medical assistants were only separated by 0.3 points. The statistical analysis shows that there is no significant difference between doctors and medical assistants with a p-value of more than 0.05 and there is a significant difference between nurses and health attendants compared with doctors ($p \leq 0.001$); however, the difference was minimal with 1.6 points between all job statuses.

Based on adjusted value whereby demographic characteristics and KAP indicators, such as age, job duration, gender, workplace, and family history of TB were simultaneously adjusted, the findings were similar to crude difference mean scores. Doctors had the highest knowledge mean score and health attendants had the lowest mean score with a difference of 4.9 points. The attitude mean score among health attendants was the lowest with 5.9 points between the highest job status mean score, which were

doctors with 61.2. Similarly, nurses had the highest in practice mean scores with 66.2. There is no significant difference (p value = 0.506) between doctors and medical assistant . Although the statistical analysis shows there is difference between doctor and nurses, the difference was minimal with only 1.6 points.

Table 3.4: The association between job status and KAP scores.

	Doctors	Nurses		Medical Assistants		Health Attendants	
		Difference (95% CI)	P	Difference (95% CI)	P	Difference (95% CI)	P
Knowledge							
Crude	Reference	-2.4 (-2.9 to -1.7)	≤ 0.001	-2.2 (-2.9 to -1.4)	≤ 0.001	-4.6 (-5.4 to -0.4)	≤ 0.001
Adjusted	Reference	-2.5 (-3.2 to -1.8)	≤ 0.001	-2.2 (-3.0 to -1.5)	≤ 0.001	-4.9 (-5.7 to -4.0)	≤ 0.001
Attitude							
Crude	Reference	-3.6 (-4.3 to -2.8)	≤ 0.001	-2.4 (-3.3 to -1.5)	≤ 0.001	-5.6 (-6.6 to -4.7)	≤ 0.001
Adjusted	Reference	-3.3 (-4.1 to -2.5)	≤ 0.001	-3.0 (-4.0 to -2.1)	≤ 0.001	-5.9 (-6.9 to -4.9)	≤ 0.001
Practice							
Crude	Reference	1.6 (0.9 to 2.2)	≤ 0.001	-0.3 (-1.1 to 0.6)	0.543	-1.4 (-2.3 to -0.6)	≤ 0.001
Adjusted	Reference	1.6 (0.8 to 2.3)	≤ 0.001	-0.3 (-1.2 to 0.6)	0.506	-1.4 (-2.2 to -0.5)	≤ 0.003

*adjusts for age (years), job duration (years), gender, workplace (hospital/clinic), and family history of TB

Table 3.5 shows the prevalence of different categories of KAP by job status. KAP scores were divided into three categories based on the Blooms criteria scoring system: high, moderate, and low. Overall, more than half of the participants (55.7%) have high knowledge of TB, followed by 44.1% with moderate knowledge, and only 0.2% or six participants with low knowledge of TB. Based on job status, doctors had the highest percentage of high knowledge with almost 68%. Nurses and medical assistants had similar percentages of high knowledge at approximately 55%, and health attendants had the least with 43%. Based on statistical analysis, there is a significant difference (p value <0.05) in knowledge categories by job status.

The majority of participants (72%) scored in the neutral attitude category, whereas only 9.8% of participants indicated a positive attitude towards TB disease and prevention. Based on job status, doctors had the highest percentage of positive attitude with 18.3%, followed by medical assistants at 12.1%. Health attendants had the highest percentage of negative attitude with 30.9%. Almost 75% of participants indicated good practice and 23.9% indicated fair practice. Based on job status, the majority of doctors (68.8%) scored in the good practice category followed by fair practice with 29.3%. Nurses had the highest percentage of good practice with almost 80% followed by fair practice with 20%. Similarly, the majority of health attendants and medical assistants (67% and 72%, respectively) scored in the good practice category followed by fair practice with 26% and 30%, respectively

Table 3.5: Prevalence of different levels of KAPs by job status

Covariates	Overall n (%) (**N=3,344**)	Doctor n (%) (**N=564**)	Nurses n (%) (**N=1706**)	Medical Assistant n (%) (**N=602**)	Health Attendant n (%) (**N=472**)	P-value
Knowledge						
High (≥80%)	1,862 (55.7)	383 (67.7)	952 (55.8)	324 (53.8)	203 (43)	≤0.001
Moderate (60-79%)	1,476 (44.1)	181 (32.1)	751 (44)	277 (46)	267 (56.6)	
Low (<60%)	6 (0.2)	1 (0.2)	3 (0.2)	1 (0.2)	2 (0.4)	
Attitude						
Positive (≥80%)	328 (9.8)	103 (18.3)	123 (7.2)	73 (12.1)	29 (6.1)	≤0.001
Neutral (60-79%)	2,400 (71.8)	404 (71.6)	1276 (74.8)	423 (70.3)	297 (62.9)	
Negative (<60%)	616 (18.4)	57 (10.1)	307 (18)	106 (17.6)	146 (30.9)	
Practice						
Good (≥80%)	2,499 (74.7)	388 (68.8)	1357 (79.5)	437 (72.6)	317 (67.2)	≤0.001
Fair (60-79%)	798 (23.9)	165 (29.3)	340 (19.9)	156 (25.9)	137 (29)	
Poor (<60%)	47 (1.4)	11 (2)	9 (0.5)	9 (1.5)	18 (3.8)	

Table 3.6 describes the association between job status and high knowledge, positive attitude, and good practice with doctors as the reference group. By utilizing multivariable logistic regression analysis, doctors scored the highest in the high knowledge category, whereas health attendants had the lowest score in this category. Health attendants, medical assistants, and nurses were 64%, 46%, and 40% less likely to have a high knowledge compared to doctors, respectively. After adjustment for age, job duration, gender, workplace, and family history of TB, these results also showed that there is a significant difference (p value <0.05) in high knowledge between job statuses. Following adjustment, health attendants were 67% less likely to have high knowledge scores compared with doctors, followed by medical assistants and nurses with 46% and 43%, respectively.

Regarding positive attitude by job status, doctors had the highest score and health attendants had the lowest. Health attendants were 3.45 times less likely to have positive attitude compared with doctors and medical assistants and nurses were 1.61 and 2.75 times less like to have positive attitude in comparison, respectively. The results showed there is a significant difference between doctors and medical assistants in crude odds ratio, which indicates there is difference in positive attitude between doctors and medical assistants. After appropriate adjustment was made, all job statuses were found to be statistically significant for positive attitude, whereby health attendants had the least positive attitude and doctors had the highest positive attitude among all job statuses.

Nurses scored the highest in the good practice category, whereas health attendants scored the least. Nurses were 1.76 times more likely to have a good practice score compared with doctors, whereas medical assistants and health attendants were 1.2 and 0.7 times more likely to have good practice in comparison, respectively. The differences between doctors and health attendants and medical assistants were small and non-

significant ($p > 0.05$). After appropriate adjustment was made, the result was similar with nurses scoring the highest for good practice, and no difference between doctors, medical assistants, and health attendants in terms of good practice scores.

Table 3.6: The association between job status and high knowledge, positive attitude, and good practice.

	Doctor	Nurses		Medical Assistant		Health Attendant	
	OR (95%CI)	OR (95%CI)	P	OR (95%CI)	P	OR (95%CI)	P
High Knowledge							
Crude	Reference	0.60 (0.49-0.73)	≤0.001	0.56 (0.44-0.70)	≤0.001	0.36 (0.28-0.46)	≤0.001
Adjusted	Reference	0.57(0.46-0.71)	≤0.001	0.54 (0.42-0.70)	≤0.001	0.33 (0.25-0.43)	≤0.001
Positive Attitude							
Crude	Reference	0.35 (0.26-0.46)	≤0.001	0.62 (0.45-0.86)	0.004	0.29 (0.19-0.45)	≤0.001
Adjusted	Reference	0.40 (0.29-0.56)	≤0.001	0.51 (0.35-0.73)	≤0.001	0.29 (0.18-0.45)	≤0.001
Good Practice							
Crude	Reference	1.76 (1.43-2.18)	≤0.001	1.20 (0.93-1.55)	0.155	0.93 (0.71-1.20)	0.574
Adjusted	Reference	1.76 (1.40-2.25)	≤0.001	1.20 (0.91-1.57)	0.195	0.96 (0.73-1.26)	0.744

*adjusts for age (years), job duration (years), gender, workplace (Hospital/Clinic), and family history of TB.

3.5 Discussion

3.5.1 Sociodemographics

Four job categories were included in this study: doctors, nurses, medical assistants, and health attendants. Doctors were the youngest (five years younger than health attendants based on mean age) and had the shortest job duration (half of the duration of health attendants).

It was interesting to find that overall, only half of the respondents from the sample of 3,344 felt that they are adequately equipped concerning KAP on TB prevention. This indicates a serious issue, as Malaysia is considered a moderate-burden TB disease country but only half of their HCWs believe that they are well prepared with KAP for TB prevention. This highlights an opportunity for identifying and providing adequate training to HCWs to fill this gap.

Based on the source of information, respondents in general gained and obtained most knowledge from their professional colleagues and printed materials, such as leaflets and pamphlets. However, one limitation of this study was that social media was not included as an option for a source of information in the questionnaire. This is mainly due to maintain the originality of the validated questionnaire which does not include the social media. However,in future studies, social media should be included as an option for source of information. Despite this, the results show professional colleagues play an important role in disseminating KAP concerning TB disease and prevention. It is important to educate and train HCWs with the right information and right method, as they will share their knowledge with their colleagues or juniors directly and indirectly.

3.5.2 Knowledge of TB

Questions aimed as assessing knowledge were divided into eight subtopics: introduction, symptoms, transmission, risk factors, investigation, treatment, prevention, and vaccination. Based on these subtopics, overall, respondents obtained the lowest percentage score on questions related to the transmission of TB with 71%. These findings were in contrast with other studies from Iraq, India, and South Africa that indicated scores of 98.2%, 95%, and 86.1%, respectively. These lower scores were generally along all four job categories. It is important to highlight the lowest percentage scores to ensure adequate focus and training, especially on health education, to improve the knowledge of HCWs concerning the transmission of disease (Hashim, 2003; Wu, 2010; Bhebhe, 2014).

Further, respondents indicated good knowledge on symptoms and treatment of TB with a total percentage score of 91.0% and 93.8%, respectively, which correlates with studies in Vietnam and South Africa with 98.0% and 94.0% for symptoms and 92.0% and 96% for treatment, respectively (Hoa, 2005; Bhebhe, 2014).

This study also showed that 55.7% of the respondents demonstrated high knowledge and 44.1% moderate knowledge. This finding closely correlates with a study done in Thailand in which 56.0% of healthcare providers were found to have "good" knowledge of TB, whereas 43.87% had a fair level of knowledge. However, this finding was much lower than findings in Iraq, Argentina, and South Africa with 98.4%, 100%, and 86.1%, respectively. The higher scores in the latter studies could be due to a few reasons. First, regarding the study from Argentina, all the participants were doctors. Second, the study in South Africa used a different scoring system and methodology for “good knowledge” (Hashim, 2003; Dato, 2009; Bhebhe, 2014).

3.5.3 Attitude towards TB

This study showed that overall, 9.8% of the respondents have a positive attitude towards TB disease and prevention. This finding was very much in contrast to a study

conducted in Thailand (56.1%), South Africa (65.0%), India (68.0%), and Iraq (91.0%). The vast difference of positive attitude among HCWs from this study was due to a variety of reasons, mainly differences in methodology and scoring systems. This study shows the majority of respondents (72.0%) were in the neutral attitude category, and remaining responses were approximately equal between the negative attitude and positive attitude categories (Lertkanokkun, 2013; Bhebhe, 2014; Wu, 2010; Hashim, 2003).

Based on job status, doctors had the highest percentage of positive attitude followed by medical assistants and health attendants with the lowest. This finding was similar to findings in India. However, the positive attitude percentage among doctors in this STEP study was much lower compared with other studies.

Almost one-third of health attendants scored in the negative attitude category, and only 6% scored in the positive attitude category. This finding was lower compared with findings in India and South Africa. The studies also showed that health attendants and nurses were 61% and 65%, respectively, less likely to have a positive attitude compared with doctors, which indicates this gap is significant and serious attention should be given to these job categories.

3.5.4 Practice on TB prevention.

This study showed that 74.7% of respondents have good practice concerning TB prevention and only 1.4% have poor practice. This finding was slightly lower from other studies but much higher when comparing findings from neighbouring countries in South East Asia, such as Vietnam and Thailand (Hoa, 2005; Lertkanokkun, 2013). Therefore, it is evident that the practice of TB prevention among HCWs in Malaysia is very good, as 98.6% of respondents in this study scored either in the good or fair category regarding practice on TB prevention. However, there is still room for improvement to ensure HCWs reach and remain in the good practice category.

Based on job status, nurses had the highest percentage of good practice. This likely because nurses have fixed annual training and biannual courses for infection control in Malaysia. This training has improved their practice on infection control, such as hand washing and handling PPE. Notably, there is no fixed or standard training given to other job statuses in all states. Each state has their own method of delivering their training, which mainly focuses on nurses. Additionally, no statistical difference in good practice was found between doctors and medical assistants or health attendants.

These results indicate that healthcare policymakers should be aware of this gap and engage all HCWs in related continuing education programmes. Studies have suggested improving HCWs KAP by health education training, and they have presented evidence that even shorter courses may significantly improve HCWs KAP regarding infection control programmes (Ahmed et al., 2013; Lavin et al., 2015).

The results showed that slightly more than half of HCWs (55%) in Malaysia have high knowledge, 10% of them have a positive attitude, and 75% have good practice. We can see a positive correlation between HCWs KAP on TB prevention and there is a strong positive correlation between high knowledge and good practice. Based on job status, this study showed that doctors had a positive correlation with KAP, as 68% of doctors had the high knowledge and 69% had good practice; however, the majority of doctors scored in the neutral attitude category. Similarly, there was a strong positive correlation between knowledge and practice among nurses. Nurses demonstrated the highest percentage of good practice compared with other job statuses. Further, the majority of health attendants indicated moderate knowledge with neutral and negative attitudes (90%) and fair and poor practice (33%).

These findings are not surprising as attitude and practice of HCWs are reliant on multiple aspects that include culture, societal norms, and individual beliefs. For instance, studies reveal that though HCWs are familiar with the necessary practice of the use of

gloves while handling sputum samples and wearing an N95 face mask, few practice it due to the high patient turnover rate. Further, the HCW ratio leads to hectic schedules, unavailability of resources, and financial constraints. This, in turn, leads to inadequate amenities, equipment, and working materials, such as gloves and N95 facemasks. In addition, in some health facilities, certain practices might not be considered as the norm and so may not be practised regardless of the knowledge level. Attitudes are also associated with familiarity and routines, e.g., in settings where the job description becomes a routine, HCWs may feel overly comfortable with their job and practices, leading to a lapse in the necessary rigour required. These factors may account for neutral attitudes on TB prevention despite adequate knowledge about modes of transmission and preventive measures. Workplace atmosphere, HCWs training, accessibility of supplies, and a decent well-designed management framework not only define compliance but also modify the attitudes and practices therein. Further contributing factors are prevalent and must be elicited through advance studies for appropriate interventions.

The positive correlations between knowledge-attitude, knowledge-practice, and attitude-practice in this study confirm the relationship between KAP and TB disease and prevention. It can be concluded that high knowledge can create a positive attitude, leading to good practices. The findings are consistent with the results of some previous studies and the health belief model helps to explain the reported positive correlations. In particular, an individual's intention to perform a behaviour is a function of their attitude leading to that behaviour. Moreover, attitude towards conduct is determined by the individual's belief that a certain outcome will arise if one adheres to that conduct. In this context, in the present study, TB prevention practices as a performed conduct were influenced by the attitude of the HCWs towards TB disease. Therefore, it can be concluded that accurate knowledge leads positive attitude, which in turn results in a positive change in the practices of HCWs.

3.6 Strengths and Limitations of the study

3.6.1 Strengths

This study was the largest study in the country to assess KAP on TB among HCWs in Malaysia. This study involved 11 out of 14 states in Malaysia and total of 3,344 respondents participated in this study.

3.6.2 Limitations

Even though the data was collected using a structured questionnaire, it was self-reported and one cannot discount the existence of a personal desirability bias. In other words, respondents might not have reported their actual perception and practice behaviour. Subject recall and social desirability bias may have been a problem given the reliance on self-report data for the cross-sectional study. Survey anonymity might have assisted to reduce social desirability bias. Indeed, self-reported adherence has been found to be higher than actual adherence (Henry, Campbell, & Maki, 1992; Henly & Larson, 2001; O'Boyle, 2003; Rickard, 2004). The observational study was designed to mitigate this limitation. Since it was a KAP study, there is no gold standard to measure TB knowledge, which made the comparison of the findings with other studies somewhat difficult.

Besides that, convenience sampling method was chosen and participants were not randomised in this study. However, there a few limitations of convenience sampling. By choosing the convenience sample method of choice may suffers from biases in this study. Convenience sample can lead to the under-representation or over-representation of particular groups within the sample. Therefore, the KAP scores result may under-represent or over-represent the real level of Knowledge, attitude and practice on TB and prevention. In this study, we may have missed the differences in job categories participants who participated and not participated in this study. Besides that, we also do not know why some HCWs agreed to take part in the survey, whilst others did not. Was

it because some HCWs were simply too busy to participate or they did not trust the intentions of the survey or they took part in this study out of kindness and these types of bias are quite typical in convenience sampling.

List of limitation due to convenience sampling in this study:

1. Possible Bias in Data Gathering

This method can get the views of specific group HCWs on TB prevention and not the whole population. Hence, if some groups are over-represented or under-represented, this can affect the quality of data being gathered.

2. Possibility of Sampling Error

Since the selection process is already biased, there are inaccuracies that are bound to set in. This type of discrepancy is known as sampling error.

3. No Generalized Results

Based on convenience sampling method, implementing this method lead to the difficulty of acquiring generalized conclusions that have been drawn from the research. This is because it is not possible to draw conclusions just by simply what a biased sample say. Most of all, it is not possible to formulate laws or rules, but identifying trends is. Likewise, it is not reliable to make a statement based on the misrepresentation of data from a chosen group of people alone.Therefore, the results of this study cannot be generalised to other healthcare workers and these results does not representative of all healthcare workers in Malaysia. However, despite the result does not generalised the whole HCW population, the result can be a good indicative rather than definitive result outcome.Lastly, option of social media was not included in the questions related to source of information on Tuberculosis. Social media plays an important role with current

advancement of technology, therefore, ,social media options should be included in future research studies.

3.6.3 Recommendations

Training given to participants should focus on improving KAP related to TB prevention. This training programme must be done periodically. Based on the results of this study, conducting such a programme once a year would likely retain the information and reinforcement programme annually will improve KAP on TB among HCWs. We believe that the practical significance of this study and public health outcomes of STEP are improved awareness on TB prevention, this will reduce the incidence of Tuberculosis among healthcare workers in Malaysia which indirectly reduce the transmission of this disease to others. Besides that, STEP programme will ensure HCWs will be a good platform to train and orientate the new HCWs during orientation which give importance on infection control on preventive practice mainly Tuberculosis

Besides that, Policy makers should be more focused on study curricula and continuing education courses regarding TB prevention to ensure that the quality of courses and practical training is focused on evidence-based practice with practical training

3.7 Conclusion

The cross-sectional study in this research project addressed two keys research questions. The first aspect of the study was an assessment of current level of KAP and the second was to identify the association between job status and KAP relating to TB disease and prevention among HCWs in Malaysia. The results of this study and their significance are presented in the following sections.

The results revealed that only 55% of participants among all four job statuses have high knowledge on TB prevention, less than 10% have a positive attitude, and 75% have good practice on TB prevention. This shows the current practice is quite impressive with

the majority of HCWs indicating good practice. However, there is room for improvement. More attention must be given to improving knowledge and, more importantly, to improving HCWs attitude towards TB disease and prevention.

Based on job status, health attendants require immediate action to improve their KAP because despite working on the front line in healthcare facilities, they had the lowest percentage of high knowledge, positive attitude, and good practice compared with other job statuses. This study thus provides an important baseline measure of the level of KAP on TB disease and prevention. The findings imply that a standard programme focusing on KAP on TB should be implemented and incorporated into the HCWs training programme on a regular basis to produce a competent and autonomous healthcare professional who has good knowledge and a positive attitude with good practice concerning TB disease and prevention. However, these result findings are applicable to participants who participated in this study and not applicable or generalised to all public healthcare workers in Malaysia due to limitation of convenience sampling. Even though the result was not definitive due to this limitation but these results are very good indicative which is useful as a baseline and represent as a rough guide for future studies

CHAPTER 4: DEVELOPMENT OF STANDARD TUBERCULOSIS EDUCATION PROGRAMME (STEP) FOR TB PREVENTION

4.1 Introduction

A standard health education programme on TB is essential to educate and conduct training for HCWs in Malaysia on TB disease and prevention. Although Malaysia is categorised as a moderate TB disease burden country, it is surrounded by high disease burden countries, such as Indonesia and the Philippines.

The Standard TB Education Programme (STEP) was designed and developed based on three sources: published literature on health education programme, mainly TB disease and infection control; TB guidelines for HCWs produced by the U.S. CDC; and an appropriate and ideal learning process whereby the main objective is to bridge the gap and correlate between theoretical knowledge and clinical practice and which is derived from the evaluation of educational theory. STEP was defined as a full day course with six lesson, 8-hour sessions that includes hands-on demonstration and group discussion that focus on the introduction of transmission and the development of TB, diagnosis, treatment, and preventive measures. A panel of experts comprised of two public health physicians and one general physician from MOH were invited to evaluate and examine the accuracy and appropriateness of this lesson. Overall, the mean score of the evaluation was 4.5 out of 5, which meant that the aims, objectives, content, and teaching process of this programme were ‘suitable' and appropriate for HCWs.

A standard health education programme on TB is essential to educate and conduct training for HCWs in Malaysia regarding TB disease and prevention. However, no such programme exists in Malaysia. Moreover, findings from MOH Malaysia showed that their source of training material was not verified or validated by experts on the appropriateness of the training material for targeted participants. Therefore, it is important to introduce and implement a health education programme with a focus on improving and equipping HCWs with adequate knowledge and skills to deal with real-life situations in

their daily clinical practice, together with the right attitude and practice in their management and disease prevention strategies.

In view of these needs, a specific health education programme relevant to TB disease, infection control precautions, and preventive measures combined with an ideal situated-learning teaching model approach to improve KAP on TB disease and prevention was designed. This education programme was named the STEP programme. In this chapter, the development of STEP programme will be outlined, focusing on the purpose of STEP, method of assessment of the education approach, teaching methods, and activities.

4.2 Literature Review

4.2.1 Development of the health education programme

Programme development is one of the most important parts in this study. STEP was designed and developed to narrow the gap and correlate between infectious disease prevention practice and theoretical knowledge. It can be argued that based on the present study, there are problems concerning the lack of KAP towards TB, including infection control issues in health facilities among HCWs. Importantly, this issue could be addressed and resolved more effectively by providing HCWs with an education and training programme that employs the most appropriate approach and content regarding TB.

4.2.2 Education approach/theory

Research findings on teaching methods in Malaysia showed that the traditional teacher-centred learning approach was widely used. In this method, students were trained and expected to listen to their teacher passively (Lee-Hsieh, Kao, & Tseng, 2004). This method of teaching is very common in Malaysia as well as other parts of the world. For instance, Schaefer and Zygmont (2003) conducted a study with 187 nursing faculty members in Philadelphia and found that their teaching methods and style were more

closely related to teacher-centred than student-centred. Additional literature indicates that educators prefer to teach based on classroom teaching with prescribed texts and this method is unable to equip nurses with skills and competence of independent learning (Gow & Kember, 1993; Shaefer & Zygmont, 2003). Further, the traditional teacher-centred approach leads students to become more passive learners and memorising the lesson taught with the goal purely to pass the examination (Candela, Dalley, & Benzel-Lindley, 2006; Gow & Kember, 1993; Saroyan & Snell, 1997; Shaefer & Zygmont, 2003). Consequently, after graduating from a programme focused on passive learning, the newly qualified HCWs eventually face reality when they are expected to be capable of problem-solving and become autonomous practitioners (D'A Slevin & Lavery, 1991; Sweeney, 1990). Sweeney found a disconnection and mismatch between knowledge that was obtained in the classroom and knowledge application in a real-life scenario in clinical settings. However, this method of teaching is commonly used in HCW education in Malaysia. This teaching approach is not suitable for disease-based or infection control education. A focus on training and education is required if the objective is to educate and train HCWs who can effectively respond to an infectious disease situation. The STEP programme module could minimise the issue of mismatch or disconnection and improve attitudes of HCWs in clinical practice. Therefore, student-centred learning integrated with situated-learning strategy (scenario-based) approach was utilized in this study to reinforce and embed learning and ability, as well as to narrow the theory-practice gap.

4.2.2.1 Student-centred learning

The student-centred learning approach was introduced in the 1960's (Rolfe, 1993). The main concept of student-centred teaching is focused on equality based on power sharing between the educator and student. In this method of teaching, active participation from students is required in the content and process of learning to explore and develop various skills (Jasper, 1995; Playle, 1996; Shaefer & Zygmont, 2003). Moreover, the

educator allows HCWs to exercise empowerment and take responsibility for their learning by motivating and facilitating them to achieve their goal and objective. Thus, the focus of this approach is more on the application of knowledge to manage real-life clinical setting scenarios (Biggs & Moore, 1993; Candela et al., 2006; Gow & Kember, 1993; Nolan & Nolan, 1997; Shaefer & Zygmont, 2003).

Recent research evaluated the effectiveness of the student-centred teaching approach and found that this approach was more suitable to achieving the teaching objective goals on health education among HCWs and for narrowing the theory-practice gap. In addition, this approach develops critical thinking, self-evaluation, skill performance, and problem-solving skills in HCWs (Cope, Cuthbertson, & Stoddart, 2000; Griffin, 1995; Hmelo & Day, 1999; Marrow, 1997). Furthermore, it engenders a sustained desire for learning throughout their professional life through the development of life-long learning skills (Jasper, 1995; Jinks, 1999; Marrow, 1997; Playle, 1996).

4.2.2.2 Situated-learning approach

Lave and Wenger introduced the situated-learning approach in 1991, an approach derived from student-centred teaching methodology (cited in McLellan, 1996). The main idea of this approach is that the participant will gain knowledge through participating in a series of activities (Farruggia, 2003; Field, 2004; Gieselman et al., 2000; Stillman et al., 1998). The situated-learning teaching approach requires participation and cooperation from the students or participants, as knowledge is negotiated or created through debate or interaction among learners and their environment (McLellan, 1996; Pritri, 2004). In other words, situated-learning is a method that delivers skills and knowledge that can be used in real-life situations.

Specifically, Kneedbone (2003) conducted a mixed-method study to improve competence and interpersonal skills among gastrointestinal endoscopy practitioners. The researcher applied a situated-learning strategy by introducing teaching techniques, such

as role-play exercises, scenario-based assessments, and group discussion. Results indicated that this training programme successfully enhanced participants' technical expertise regarding endoscopy and communication skills (Kneedbone, 2003).

4.2.2.3 The merger of student-centred and situated-learning approaches

Previous research has merged student-centred and situated-learning approaches and found that such a combination could efficiently and effectively enhance participants' confidence, perfomance, and competency in real-life problem-solving skills (Cope et al., 2000; Farruggia, 2003; Field, 2004; Griffin, 1995; Kneebone, et al., 2003; Marrow, 1997; Stillman, Alison, Croker, Tonkin, & White, 1998). Further, Cope et al. (2000) evaluated the impacts of student-centred and situated-learning approaches compared with traditional teaching methods in nursing education in Scotland. Their findings showed that the student-centred and situated-learning approaches improved students' performance and problem-solving skills, which directly narrowed the theory-practice gap (Cope et al., 2000). Participants agreed that this teaching approach enabled them to involve and integrate into community practice with confidence (Cope et al., 2000). This teaching approach also assisted them in contextualising the knowledge gained, improving their attitude, and enabling the application of theory into practice during daily clinical tasks (Cope et al., 2000). Similar findings have been noted in a number of other studies, including Farruggia (2003), Hmelo and Day (1999), Jasper (1995), Kneebone (2003), Marrow (1997), Playle (1996), and Stillman et al. (1998).

4.2.3 Conclusion

This literature review has highlighted that the limitation or gap between theoretical knowledge and practice can be minimised significantly by introducing and implementing student-centred or situated-learning teaching approaches into education programmes. In this study, a student-centred approach was implemented to associate teaching and training

strategies into educational theory and situated-learning was applied as a strategy to incorporate theory into real-life scenario practice.

4.3 Methodology

4.3.1 The STEP programme

For this study, the educational intervention, STEP, was defined as a full-day course with six 8-hour lessons. All lessons were held in an auditorium in Sultanah Bahiyah Alor Setar General Hospital. The STEP was delivered on 17th February 2016 with the intervention group between 8 a.m. to 5 p.m. The objectives of STEP were to increase the level of knowledge of TB among HCWs and to improve their attitude and practice on TB disease and disease prevention. This would enable them to protect both themselves and their patients more effectively and indirectly minimise the risk of infection.

4.3.2 Content of the STEP

The content of the intervention was informed by the learning needs of HCWs in TB and was developed based on U.S. CDC guidelines, Malaysian Clinical Practice Guidelines on TB by MOH Malaysia, and published research studies. Content included an introduction of TB transmission and the development of TB disease, diagnosis of TB disease, treatment of TB infection, and preventive measures regarding TB. In addition, experiential learning in hand washing, cough ethics, and using and removing PPE was addressed in this programme. Group discussions were initiated to discuss facts and myths concerning TB in clinical scenarios and were applied to consolidate conceptual knowledgeability. This was achieved through the process of deployment of knowledge and the process of seeking information.

In STEP, the teaching approaches followed student centred and situated-learning approach. The programme consist of lectures which includes questions and answers, this allow participants to ask their doubt based on what they want to know about TB. A series

of lectures related to Myths and Facts on TB allow participants to actively ask and clarify all their doubt on TB disease. This session allows them to express what was their belief and understanding on TB and gain the right knowledge and facts on TB. During this session, participants will share their clinical experience and researcher will ask the rest of the participants on right approach or method to solve a particular problem during clinical practice.

Meanwhile situated learning approach were incorporated in to STEP module based on clinical scenario based assessment, role play exercises and group discussion during the programme. Participants were divided into 10 groups whereby each group were given a clinical scenario on TB disease which focuses on daily clinical practice encounter issues or problem. The group must perfume a role play for 5 minutes and discuss regarding the scenario given. The groups will present their findings and discuss with the other participants and facilitators.

The facilitator for group discussions are consist of doctors from Hospital Sultanah Bahiyah alor setar, doctor from occupational health unit, Kedah state health department and the researcher. All facilitators are trained on the requirement and content of this programme. Researcher arranged a meeting a month prior to STEP intervention programme with fascilitators to discuss on how to facilitate and assess the participants to ensure the assessment and teaching methods are standard across all groups.

4.3.3 Components in STEP

There are six lessons in the STEP programme:

Lesson 1

The purpose of this lesson is to introduce the general concepts of TB infection. This chapter includes the history of TB infection and addresses the epidemiological findings on TB among HCWs globally and in Malaysia.

Lesson 2

The purpose of this module is to introduce the general concept of transmission of TB disease. This lesson identifies ways in which TB is spreads and explains conditions that increase the risk of TB infection. Further, this lesson addresses general pathogenesis of TB.

Lesson 3

The purpose of this module is to describe and explain the signs and symptoms of both active and latent TB. This lesson also highlights the difference between latent TB infection and active TB disease. This lesson also aims to educate the participant on investigation practices by explaining the five components of a medical evaluation for TB disease and five components of a TB bacteriological examination.

Lesson 4

The purpose of this lesson is to explain the treatment of TB disease and identify potential adverse reactions to the drugs used to treat TB infection. The importance of completing treatment is addressed as well. This lesson also focuses on DOTS.

Lesson 5

The objective of this module is to explain preventive measures of TB. These preventive measures generally discuss administrative control, engineering control, and personal protective measures, including proper usage of PPE such as respiratory masks, gloves, and gowns. This health education module emphasises the components and

concepts of control measures. One allocated session focuses on hands-on practice of proper handwashing and one session focuses on applying and removing PPE. All components are reviewed to consolidate participants' knowledge and improve their daily clinical practice in the workplace.

Lesson 6

This lesson allocates a one-hour hands-on demonstration of proper use of PPE. All concepts of infection control practice, components of standard and additional precautions, and the application of PPE are reviewed and summarised to consolidate student knowledge as well as improve their disease prevention clinical practice.

Table 4.1: Components of STEP teaching process.

Lesson	Duration	Content	Teaching Process
1 - Introduction to TB	1 hour	1. Describe what causes TB (TB). 2. Describe the global situation of TB. 3. Briefly explain factors that contributed to the global resurgence of TB. 4. Challenges to TB control in Malaysia. 5. Incidence and prevalence of TB among HCWs in Malaysia.	Lecture, group discussion, and feedback/integration.
2 - Transmission of TB	1 hour	1. Explain how TB is spread. 2. Explain how latent TB infection and TB disease develop. 3. Explain the difference between latent TB infection and TB disease.	Lecture, group discussion, and feedback/integration.

Table 4.1, continued

3- Diagnosis of TB	1 hour	1. Explain signs and symptoms of TB and the concept of targeted testing. 2. List groups at high risk for infection for M.TB. 3. List groups at high risk for progression to TB disease and methods that can be used to test for TB infection.	Lecture, group discussion, and feedback/integration.
4 – Treatment of TB	1 hour	1. Explain why TB infection needs treatment. 2. Explain DOTS and describe treatment regimens for TB infection. 3. List potential adverse reactions to the drugs used to treat TB infection. 4. Describe TB treatment adherence strategies.	Lecture, group discussion, and feedback/integration.

Table 4.1, continued

5 – Prevention and control measures of TB	1 hour	1. Explain preventive measures of TB. 2. Explain the importance of hand hygiene and PPE. 3. Describe the TB screening programme. 4. Discuss what we can do as HCWs to prevent TB in workplace.	Lecture, group discussion, and feedback/integration.
6 Hands-on demonstration of universal precaution	1 hour	1. Introduction to the correct sequence for applying and removing PPE. 2. Hands-on practice of applying and removing PPE and proper method of hand washing.	Demonstration, hands-on practice, and feedback/integration.

4.3.4 Teaching processes and learning activities

Content of the STEP was organised in which both the theoretical and practical components were included in each chapter. Other strategies such as reading, questions and answers, brainstorming, group discussions, and scenario for problem-solving were also included. Reading material handouts and references for further readings were given to every participant in the intervention group after attending the STEP programme; however, the control group received this material after the 3-month post-test assessment.

Before the commencement of the programme, the nurses were divided into 10 groups. They were engaged in a group discussion to exchange information and to help define and confirm their reasoning and judgements. The questions proposed in each lesson were designed to provide the participant with the basic concepts pertinent to the topic, to stimulate their reflection on the knowledge they learned previously, and to think about the topic more broadly. Discussion in groups was also required to exchange information, reason or redefine situations, and confirm the judgements made. Through these processes, the participant had an opportunity to boost their communication skills by reflecting on their part in communicating with others. These teaching processes occurred in a circular format that started with an intriguing question followed by brainstorming and a group discussion to define the issue and develop a solution to the problem.

As scenarios are central to situated-learning, for the STEP programme, three different clinical scenarios were selected and applied during the programme. These provided an opportunity for HCWs to participate in their learning and to improve their problem-solving skills through brainstorming, group discussion, and critical thinking. Thus, these scenarios placed HCWs in situations analogous to those of the real-world and then stimulated their thinking about appropriate reasons for, and practical judgements concerning, their actions to improve their skills. In this way, using scenarios as part of the situated-learning approach can help to bridge the gap between theoretical knowledge and

practice by presenting material in a manner that reflects the demands of solving real-world problems arising in clinical practice.

4.4 Results

4.4.1 Assessment of the STEP content validity

A panel of experts comprised of two public health physicians (one occupational health physician from Negeri Sembilan and One occupational health unit from Putrajaya Ministry of Health) and one general physician from MOH (Hospital Tuanku Jaafar) were invited to evaluate and examine the accuracy, currency, and appropriateness of this programme. A detailed research proposal, evaluation sheet, and the STEP education programme were provided to panel members to evaluate the content credibility of the STEP programme. The evaluation sheet utilised a 5-point scale (5: extremely suitable; 4: suitable; 3: neutral; 2: not suitable; 1: extremely unsuitable), which was applied by the panel to evaluate and assess programme aims, objectives, content, and the teaching and learning process.

The panel was asked to give critical feedback on the framework and major areas of this educational intervention based on evaluation sheet which was given to each expert (Appendix B) and their comments and feedback were used and incorporated into the development of STEP module to enhance its validity and appropriateness.

Public health physician from Negeri Sembilan gave feedback and suggestion after reviewing the STEP module:

I would like to suggest to you to include few slides on latent TB. Just a brief introduction on it.If possible try to include more pictures and graphics in slides rather than lengthy words.

General physician from Hospital Tuanku Jaafar commented that*:*

I was wondering if you can emphasize on hands on demonstration mainly cough hygiene and hand washing. Otherwise the contents are good and suitable for all job categories.keep it simple and easy to understand.

Meanwhile,Public health physician from Putrajaya suggested that*:*

Proper method of wearing PPE demonstration is good however I would recommend to include practical session on safe way of removing PPE mainly face mask such as N9. All the contents are relevant and appropriate for all job categories.

Based on review of panel assessment forms, All three panel of expert reviewed and assessed the STEP programme. Mean score of the evaluation was 4.5 out of 5, which meant that the aims, objectives, content, and teaching process of this programme were ‘suitable' and appropriate for HCWs. Minor changes in wording and grammar were also made according to panel comments. Through this process, the quality of the STEP programme curriculum was thus improved to ensure that it would be able to fill the gap in TB disease information.

Table 4.1: Scoring of assessment for STEP contents by panel of experts.

Lesson	**Scores**		
	Expert 1	**Expert 2**	**Expert 3**
Introduction of TB	5	5	4
Transmission of TB	4.3	4.7	4
Diagnosis of TB	3.5	4.5	4
Treatment of TB	4.5	4	5
Prevention and control measure of TB	5	5	4
Hands-on Demonstration	5	5	4
Total score	**27.7**	**28.2**	**25**

4.5 Discussion and Conclusion

This chapter outlined the educational intervention that was developed based on the review of the literature from journal articles, health education training guidelines from the U.S. CDC, and education theory. The core of this intervention (STEP programme) is to provide lessons for educating HCWs on standard and additional precautions integrated with student-centred and situated-learning strategies to bridge the gap between theoretical knowledge and scientific skills. The development, features, and content of STEP were presented. An expert panel supported the accuracy, appropriateness, and currency of this lessons. The next chapter will present the methods used to test the effectiveness of this customized TB education programme.

CHAPTER 5: EVALUATION OF THE EFFECTIVENESS OF THE STEP PROGRAMME TO IMPROVE KAP CONCERNING TB AMONG HCWs

5.1 Introduction

Health education is a social science that draws from the biological, environmental, psychological, physical, and medical sciences to promote health and prevent disease, disability, and premature death through education-driven voluntary behaviour change activities. It aims to raise awareness, expand knowledge, gain skills, and shape a health-oriented attitude of individuals. Health education is a process in which people learn how to take care of their health and the health of their community by enhancing their ability to make the appropriate health-related decisions.

The main assumption underlying the essence of health education is that the health of individuals and, consequently, communities they belong to is significantly conditioned by the behaviour of an individual through positive impact of health education. The essential task of modern health education is, first and foremost, to create the conditions for change and the growth of the competencies of individuals and groups concerning individual action related to health at different levels of social life. Health education has become a universal tool, which may be used at every stage of prevention enabling the solutions of problems at all levels.

HCWs were known as a high-risk population for TB disease. Many scientific literatures have documented the risks of transmission of TB disease from patients with TB to HCWs (Fennelly, 1999; Sepkowit, 1996). This risk is greater when the frequency and number of smear-positive TB patients are high and treated at the healthcare facility. However, the execution of preventive measures, such as the implementation of effective health education programmes that include infection control measures, can reduce and overcome this issue (Harries, 1997; Jensen, 2005). Recently, high incidences of TB disease among HCWs have led to recommendations for a comprehensive set of infection

control practices and implementation of an effective health education programme to protect HCWs (Fennelly, 1999; Jensen, 2005). Based previous studies, it is evident that in the years following the implementation of an infectious disease prevention programme, there was a significant decline in the burden of TB disease among HCWs (Fennelly, 1999; Jensen, 2005).

Although the incidence of TB disease in the general population and HCWs among high-income countries was less than 10 and 25 per 100,000 per year (Seidler, Nienhaus, & Diel, 2005), this is not the case in middle- and low-income countries (LMICs), which account for more than 90% of the global TB burden because they have high TB incidence rates and a limited supply of resources (Jones-Lopez, 2005; Makinen et al., 2000; van Gorkom, 1999; Whitehead, 2001). Therefore, high-burden countries must concentrate mainly on case detection and treatment using the DOTS strategy (Fennelly, 1999; Jones-Lopez, 2005). In these countries, even low-cost strategies to reduce TB transmission in healthcare facilities are seldom implemented (Harries, 1997).

Based on a World Bank report in April 2017, Malaysia is categorised as an upper-middle-income country. Therefore, Malaysia is facing a similar situation as other low- and middle-income countries concerning the burden of TB disease. Therefore, immediate and necessary action must be taken to improve infectious disease prevention and control programmes for HCWs in Malaysia.

5.1.1 Conceptual framework for intervention programme: knowledge, attitude, preventive practice, and outcomes (KAP-O) framework

Previous studies and reviews have proven that health education intervention enhances and improves the KAP of participants towards infectious disease and prevention. Therefore, the KAP-O model of behavioural change as proposed by Wan (2014) forms the ideal theoretical basis for this study's examination of the underlying

mechanism by which educational intervention may improve health care outcomes. The application of KAP-O in a pre- and post-test study may reveal the relative importance of predictors for the variation in TB outcomes.

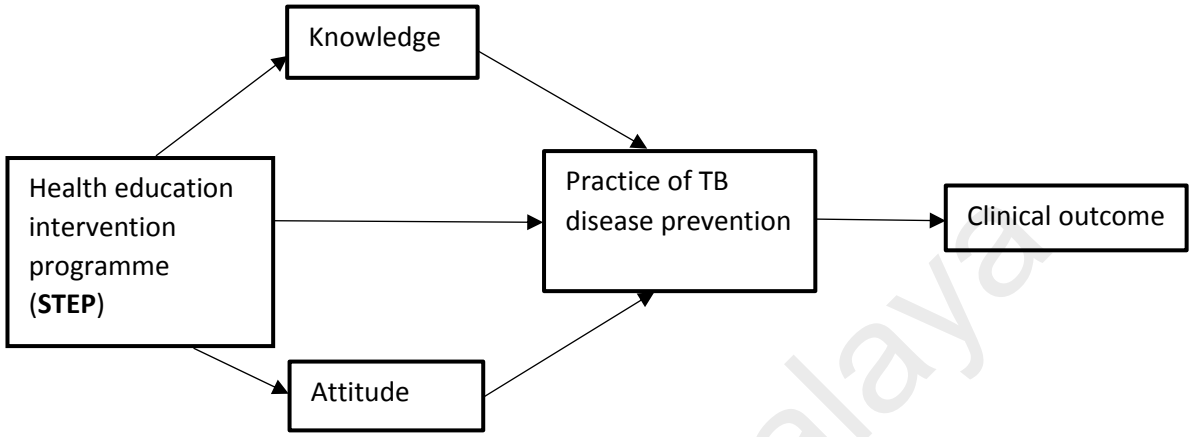


Figure 5.1: Relationship of KAP-O components in STEP

5.1.2 Framework for Program Evaluation in Public Health

Program evaluation is a systematic method for collecting, analysing, and using information to answer questions about projects, policies and programs(C.D.C MMWR ,1999), particularly about their effectiveness and efficiency. In both the public and private sectors stakeholders often want to know whether the programs they are funding, implementing, voting for, receiving or objecting to are producing the intended effect. While program evaluation first focuses around this definition, important considerations often include how much the program costs per participant, how the program could be improved, whether the program is worthwhile, whether there are better alternatives, if there are unintended outcomes, and whether the program goals are appropriate and useful.(Shackman, 2012).Evaluators help to answer these questions, but the best way to answer the questions is for the evaluation to be a joint project between evaluators and stakeholders. (C.D.C, 2012).

Effective program evaluation is a systematic way to improve and account for public health actions by involving procedures that are useful, feasible, ethical, and accurate. The recommended framework was developed to guide public health professionals in using program evaluation. It is a practical, nonprescriptive tool, designed to summarize and organize the essential elements of program evaluation. The framework comprises steps in evaluation practice and standards for effective evaluation (Figure 5.2).

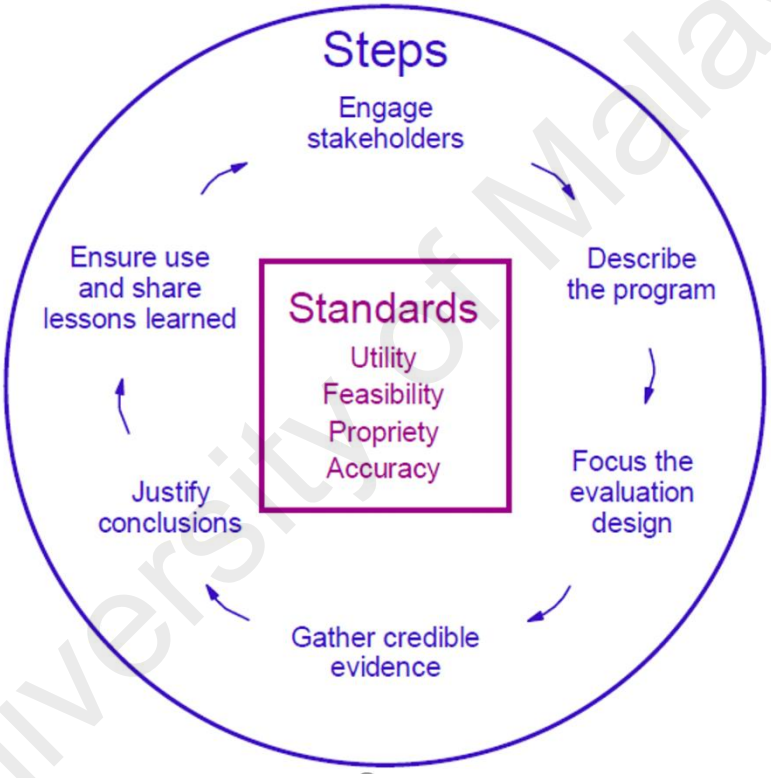


Figure 5.2: Framework for Programme Evaluation (CDC)

CDC's (1999) framework for program evaluation in public health provides a series of practical steps for conducting a program evaluation. This model incorporates and operationalizes the guiding principles, or "standards," of utility, feasibility, accuracy, and propriety. Figure 1 provides an overview of CDC's program evaluation framework with the following series of steps, which begin at the top of the circle and proceed clockwise:

1. Engage stakeholders and partners to ensure that the evaluation addresses important elements of the program. Stakeholders and partners may include (a) people involved in program operations (e.g. Ministry of health, state health department), (b) people served or affected by the program (e.g., healthcare workers, specific ethnic communities, family members, neighbourhood organizations, academic institutions, elected officials, advocacy groups, professional associations, sceptics, opponents, staff of related or competing organizations), and (c) primary users of the evaluation.

2. The program must be described clearly enough to convey its mission and objectives. Relevant components may include assessed need, expected effects, program activities, available resources, stages of program development and provider readiness, and social-ecological context.

3. Researcher must establish a clear focus and evaluation design by identifying users and uses, developing questions and methods, and making formal agreements among stakeholders to ensure that the evaluation assesses issues of greatest concern to stakeholders while using time and resources efficiently.

4. Researcher must identify and gather credible evidence from reliable sources, maximizing the quality of the evidence while striving for parsimony and keeping logistics as uncomplicated and resource efficient as possible.

5. Researcher also must be able to justify conclusions and recommendations, linking them to the gathered evidence and judging them against agreed-on values or standards set by stakeholders. Recommendations require not only judgments about a program's effectiveness but also information about the context in which stakeholders will make program decisions.

6. Finally, the researcher must ensure the use of the results and share the lessons learned. These processes do not automatically follow from an evaluation. They require inclusion

of preparation of feedback and follow-up, and appropriate dissemination in the design of the evaluation.

These steps, and their underlying principles, reflect the participatory nature of good evaluation. Given the interdisciplinary and social-ecological nature of health promotion programs for older adults, staff and stakeholders need to be drawn into the process to make it less threatening, enhance the likelihood of collecting complete data, and ensure that the analysis of the findings is considered from all viewpoints and in a meaningful way. The responsibility of the evaluation effort and the determination of its scope and inclusiveness ultimately lie in the hands of the program management. However, the evaluator has professional and ethical responsibilities to urge program management to take the time to conduct a good evaluation effort as systematically as possible, with attention to the health promotion frameworks, principles, and processes that we described. The likelihood of producing useful information that can sustain successful health promotion program efforts for older adults and help staff and partners do their jobs better will more likely result by the participation of management, staff, and stakeholders.

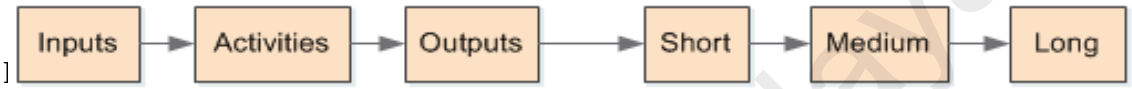
5.1.3 Logic model

A logic model is a tool used by evaluators of programs to evaluate the effectiveness of a program. They can also be used during planning and implementation. (Alter, C. & Murty, S.,1997) Logic models are usually a graphical depiction of the logical relationships between the resources, activities, outputs and outcomes of a program.(Hernandez, Mario, 2000) While there are many ways in which logic models can be presented, the underlying purpose of constructing a logic model is to assess the "if-then" (causal) relationships between the elements of the program.

The advantage of using this model is researcher or evaluator have an easier way to define the work and measure it. Performance measures can be drawn from any of the

steps. One of the key insights of the logic model is the importance of measuring final outcomes or results, because it is quite possible to waste time and money (inputs), "spin the wheels" on work activities, or produce outputs without achieving desired outcomes. It is these outcomes (impacts, long-term results) that are the only justification for doing the work in the first place.

Therefore, we used this model as a tool to evaluate the effectiveness of STEP programme.



The key components of a logic model are

• Inputs or resources

• Activities (interventions)

• Outputs

• Outcomes (short-, medium- and long-term)

Inputs or resources

Inputs or resources include the human, financial, organisational resources available for carrying out this STEP program's activities. Occupational Health Unit Kedah state Department plays an important role as organisation which take charge to organise this intervention programme which includes recruiting the participants and financial input by arranging the transportation for participants, venue and food preparation. Besides that they also appointed and trained nine facilitators together with researcher prior to intervention programme.

Activities

Activities are the processes, tools, events, and actions that are used to bring about a program's intended changes or results. In this study, STEP programme intervention are the main activities. The STEP programme activities which consist of series of lectures, presentation, hands on demonstration and group discussion on topic related to TB disease and prevention.

Outputs

Outputs are the direct products of a program's activities and may include types, levels and targets of services to be delivered by the program. In STEP programme, outputs are nurses attending the full day course health education STEP programme.

Outcomes

Outcomes are the expected changes in the population served that result from a program's activities and fall along a continuum, ranging from short to long term results. In STEP programme, the expected changes are improvement of knowledge, attitude and practice scores after intervention programme.

I. **Short term** outcomes are expected to improve knowledge and attitude
II. **Medium term** we expected a changes in behaviour in short term leads to improve in TB prevention practice
III. **Long term** changes, we expected the incidence rate of TB among healthcare workers reduced for those in intervention programme.

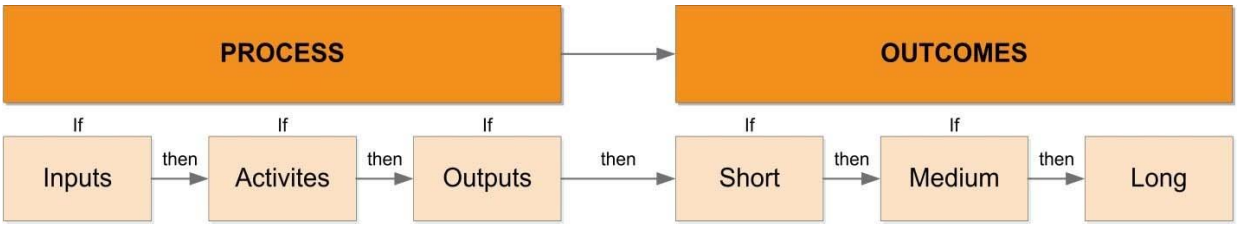


Figure 5.4: Process and outcomes of Logic model

The main importance and reason to evaluate an intervention programme are as follows:

1. Improve program design and implementation—It is important to periodically assess and adapt the STEP programme to ensure they are as effective as they can be. Evaluation can help the researcher to identify areas for improvement and ultimately help to achieve the short, medium and long-term objectives and goals more efficiently (Hornik, 2002; Noar, 2006).

2. Demonstrate program impact—Evaluation enables the researcher to demonstrate STEP program's success or progress. The information that collected by researcher allows researcher to communicate better on the intervention program's impact to healthcare workers, which is critical for staff morale as well as attracting and retaining support from current stakeholders. (Hornik & Yanovitzky, 2003).

5.2 Literature Review

5.2.1 Impact of infection control strategies on the incidence of TB infection or disease

Unfortunately, only a few studies exist concerning the implementation and application of TB health education and infection control programmes in healthcare facilities. Specifically, three studies assessed the impact of TB infection control strategies on the risk of TB infection or disease (Harries, 2002; Roth et al., 2003); two studies investigated the association between personal preventive measures of those at risk of TB disease and KAP to assess TB infection control measures among HCWs (Jelip et al., 2004; Teixeira et al., 2005); and one study explored the effectiveness of administrative control measures in Malawi. Findings have indicated that the implementation of infection control guidelines was not uniform across and there was a non-significant reduction in the incidence of TB one year after the implementation of the administrative control measures (Luksamijarulkul, 2004; Harries et al., 2002).

Further, Yanai and colleagues (2003) investigated the implementation of administrative, engineering, and personal protective control measures in a hospital in Chiang Rai, Thailand and found there was a significant reduction in the annual incidence of latent TB among HCWs (from 9.3% to 2.2%). However, there was a non-significant increase in the incidence of active TB (from 179 to 252 per 100,000) one to two years after initiation of these control measures and during the study period, there was an increase in the proportion of HIV-positive TB patients treated at that facility (from 3% to 57%) (Yanai et al., 2003).

In another study from Brazil, a cross-sectional tuberculin survey was conducted to determine the baseline of latent TB infection prevalence in four general hospitals (Roth et al., 2005). Hospital A initiated administrative controls and provided N95 respirators for all HCWs in a TB-isolation room. Hospital B had initiated administrative control measures at three months before baseline TST testing and introduced N95 respirators and started negative-pressure in TB-isolation rooms during the onset of the study. Hospitals C and D had no TB control measures in place throughout the study. Baseline TST positivity was significantly different in the four hospitals (46.7%, 69.6%, 65.8%, and 62.2% in hospitals A, B, C, and D, respectively) (Roth et al., 2005). After one year, the incidence of LTBI (in initially tuberculin-negative workers) was significantly lower in hospitals A and B compared with the other two hospitals (Roth et al., 2005).

A case-control study by Jelip et al. (2004) found that HCWs with TB disease were 4.3 times (95% CI 0.95 to 19.8) more likely to be unaware of the need for respiratory protection and 5.9 times (95% CI 0.76 to 46.4) more likely to have poor knowledge about TB transmission. Similarly, a study among medical students found that although 90% were aware of the risk of TB transmission, only 46% reported the use of personal protective measures (Teixeira et al., 2005).

Lastly, Luksamijarulkul (2004) found that despite 97% of HCWs in Thailand being aware of TB infection control policies, only half (52%) used PPE (e.g., respirators). Such failure to use personal protection has been associated with a 2.6-fold (95% CI 1.06 to 6.64) increase of the risk of TB disease in HCWs (Harries, 1999).

5.2.2 Effectiveness of health education intervention targeting on knowledge and attitude of HCWs

Education is an important factor in the prevention and management of infectious disease, especially concerning knowledge of infectious disease among HCWs to ensure they are able to provide adequate care to their patients (Atulomah & Oladepo, 2002; Bennett & Mansell, 2004; Calabro et al., 1998; Diekema et al., 1995; Jeffe et al., 1999; Moore, Gamage, Bryce, Copes, & Yassi, 2005; Won et al., 2004). Indeed, infectious disease health education or training on disease control and preventive measures assist HCWs in updating and equipping themselves with current requirements of the healthcare field, which improves patients' care and quality of life. Further, adequate health education and training improves HCWs KAP regarding disease control of TB in healthcare settings.

Research study findings have shown that infectious disease prevention and control can be accomplished by improving health education and practising hand hygiene among HCWs in the workplace. Intervention studies have shown that improved standards of education, personal hygiene (particularly handwashing), and targeted environmental hygiene have a considerable impact on the control and prevention of infectious organisms (Bennett & Kekaher, 1994; Calabro et al., 1998; Diekema et al., 1995; Jeffe et al., 1999; Gueritault-Chalvin et al., 2003; Perry, 2001; Wilm & Warbinek, 2002; Won, Chou, Hsieh, & Chen, 2004). The main objectives of clinics and hospitals in reference to disease prevention and infection control programmes are to prevent transmission to patients and staff and for the programme to be cost-effective (Warren, Zack, Cox, Cohen, & Fraser, 2003; Zack et al., 2002).

An intervention study was conducted by Won and colleagues (2004) regarding hand hygiene, which included a health education series consisting of lectures, written standard operating procedure, and reminders on proper handwashing technique in a neonatal intensive care unit in Taiwan. The effectiveness and impact of this programme were assessed through observation of nursing daily practice and prevention of nosocomial infection. The research findings showed that HCWs compliance on hand washing significantly improved from 43% at baseline to 80% post-intervention (Won et al., 2004). Furthermore, handwashing rates among HCWs remained consistent at 81% after 48 months post-intervention (Won et al., 2004). However, the limitations of study were that there was a reward and penalty system application among participants, which may affect the outcome of the study, and the observer and assessor were not trained (Won et al., 2004).

A retrospective study by Wilm and Warbinek (2002) investigated TB mortality rates in British Columbia, Canada between 1895 and 1945. The research findings showed that TB mortality reduced significantly from 200 per 100,000 population to 55 per 100,000 population in 50 years even though there was no effective cure during that time. This significant reduction in number of cases was mainly contributed by health education on infection control by health professionals with patients and their families in hospitals and the community (Wilm & Warbinek, 2002). However, it is unclear whether the significant reduction was attributed by health education alone or other factors played an important role, such as environmental factors.

Similar findings emerged from research conducted by Zack and colleagues (2002). The objective of their study was to assess the impact of health education on the rate of ventilator-associated pneumonia. In this study, a health education programme was designed that consisted of formal lectures, in-service staff hands-on training, and self-study modules on risk factors, transmission, and practice modification (Zach et al., 2002).

The participants for this programme were respiratory care practitioners and nurses from intensive care unit. The findings of this study showed that 191 episodes of ventilator-associated pneumonia occurred in 15,094 ventilator days (12.6 per 1,000 ventilator days) in the 12 months prior to health education intervention (Zach et al., 2002). However, after the implementation of the health education programme, the rate of ventilator-associated pneumonia reduced to 81 episodes in 14,171 ventilator days (5.7 per 1,000 ventilator days), which is a significant reduction of 57.6% (Zach et al., 2002). These findings provide evidence that a health education programme was effective in reducing hospital-acquired pulmonary infection.

Warrant and colleagues (2003) conducted a study to assess the effectiveness of an evidence-based intervention in preventing catheter-associated bloodstream infections at a non-teaching hospital between 1998 and 2000. The intervention programme consisted of a 10-page self-study module on the prevention of catheter-associated haematological infection. The participants of this study included nurses and physicians. The research findings showed that health education intervention was associated with a significant reduction in the incidence of catheter-associated haematological infection, with 30 cases prior to intervention and 11 cases post-intervention (Warrant et al., 2003).

Although all the three studies above provide evidence that health education intervention can successfully reduce infection rates, the content and scope of the education programme used in each study were not explained in detail. Therefore, focus should be given on methods of delivery and the content of the education programme approach used in each study to decide how it influenced the success and the outcome of the intervention. The other two studies similar as the participants were doctor and nurses, both studies used questionnaire as a research instrument to assess the effectiveness of a health education programme by conducted assessment before and after intervention programme, the programmes involved lectures and self-study modules, and the outcome

of intervention programme was measured based on the incidence of infection rates. Thus, the incidence of infection rates is also influenced by external factors, such as environmental and administration factors that include proper and adequate equipment. Even though the evidence showed a significant reduction in the incidence of infection rates, the research is unable to prove the main factor that contributed to this reduction without any bias or confounder, which may have affected the intervention factor.

Sokas, Simmens, and Scoot (1993) conducted a study to evaluate the effectiveness of a programme in improving knowledge of universal precautions and competency among medical students. The programme consisted of health education lectures for three hours followed by a hands-on demonstration. A total of 103 students participated in the study and the results showed that students' knowledge significantly improved from a mean score of 2.23 to 3.88 ($p = 0.001$) (Sokas, et al., 1993).

Calabro and colleagues (1998) conducted an intervention study to evaluate knowledge of infection control precaution among medical students ($n = 200$). The intervention study consisted of a two-hour lecture, a hands-on demonstration of infection control, such as proper handwashing demonstrations, and discussions on real clinical scenarios. The result on post-intervention showed that there was a significant improvement in knowledge scores on infection control procedures (Calabro et al., 1998). The programme content and teaching method were explained in detail in this study. The researchers believed that the content process in the programme played a major role in the success of this intervention study, as many studies have reported positive results for education interventions adopting a student-centred approach (Cope, Cuthbertson, & Stoddart, 2000; Gieselman, Stark, & Frarruggia, 2000; Jinks, 1999; Kember, 1997; McLellan, 1996; Perry & Paterson, 2005; Pitri, 2004). However, no information was provided on the reliability or content validity of the instrument used.

In Nigeria, Uwakwe (2000) assesses the KAP towards HIV/AIDS among 141 nurses participated in the study and pre- and post-test assessments were conducted with both intervention and control groups. The intervention programme included a three-month HIV/AIDS health education course. Questionnaires were used to evaluate programme on nurses' knowledge, attitude, and compliance concerning universal infection precautions. The results showed significant improvement in nurses' knowledge on safety procedures for handling contaminated blood and symptoms and transmission of HIV/AIDS as well as their attitudes towards the disease (Uwakwe, 2000). Therefore, the researcher concluded that a health education programme is essential and must begin during undergraduate education to improve knowledge, attitude, and behaviours among student nurses and be followed by in-service HCWs training programmes (Uwakwe, 2000).

The major factor of success from the above studies was based on their approach to the health education programme. A problem-based participatory approach teaching method was chosen, which consisted of seminar, lectures, and multimedia presentations. The different approach of teaching strategies could have contributed to the effectiveness of the health education programme (Polit & Beck, 2004).

McCann and Sharkey (1998) conducted a health education intervention study to assess knowledge, attitude, and willingness to provide care to patient with HIV/AIDS among nurses. The results showed there was a significant improvement on knowledge of infection control with improvement of median score from 2 to 3 (McCann & Sharkey, 1998). Additionally, the researchers also noted significant positive changes in attitudes towards HIV/AIDS patients and colleagues with HIV-positive (McCann & Sharkey, 1998).

A quasi-experimental study conducted in China by Wang, Fennie, He, Burgess and Williams (2003) evaluated the impact of a training programme for preventing

occupational exposure to blood borne pathogens among student nurses (n = 106). Specifically, they investigated the impact of a training programme focused on improvement of knowledge, behaviour, adherence, and compliance to universal precautions during with a four-month follow-up. The training programme consisted of a one-hour lecture, which focused on epidemiology, transmissions of blood borne infections, and technique. This was followed by 20-minute video presentation that focused on proper techniques of universal precautions. The results showed a significant improvement in knowledge on universal precautions among nurses as well as a reduction in the incidence of needlesticks after the intervention programme (Wang, et al., 2003). The findings of this study showed that the intervention programme was effective in improving on knowledge and behaviour on universal precaution and infection control among nurses. However, the instrument used in this study was not validated and tested. Therefore, this self-report format may have contributed to information bias.

In contrast, two studies (Duerink et al., 2006; Gould & Chamberlain, 1997) assessed the effectiveness of health education programmes on compliance with infection control procedures among HCWs and their findings showed that the health education intervention did not significantly improve HCWs' compliance with infectious precautions.

Overall, this review showed that there is substantial proof that health education can improve HCW's knowledge on disease and preventive measures. Research findings also showed that HCWs with a higher level of knowledge was associated with a positive attitude and good practice compliance on disease precautions, echoing previous studies (Tzeng, 2004; Wang et al., 2003).

However, there are some limitations in these studies. Firstly, some health education programmes were of relatively short duration, e.g., three hours or less (Calabro et al., 1998; Diekema et al., 1995). Secondly, the sample sizes were small with 50-60

participants (McCann & Sharkey, 1998; Wang et al., 2003). Thirdly, the sustaining effect of the health education intervention had not been tested after the intervention and post-test. Fourthly, the evaluation instruments were not all validated prior to the reported studies, and none of these studies was conducted in Malaysia. However, a positive aspect of the reviewed studies is that all were conducted specifically for HCWs (Calabro et al., 1998; Diekema et al., 1995; Jeffe et al., 1999; Sokas et al., 1993) or nurses (Gould & Chamberlain, 1997; McCann & Sharkey, 1998; Uwakwe, 2000; Zack et al., 2002), measuring their knowledge and attitudes towards infected patients and their readiness to perform procedures or to comply with infection control measures. Nevertheless, it is difficult to commit conclusively that this form of training health education could be implemented effectively in the Malaysian context. Therefore, there is a need for this research to be undertaken in Malaysia to test measures in improving healthcare worker's adequate KAP on TB disease and its control measures.

In conclusion, the health education approach is a preferred choice as the main component for a training programme for HCWs. The literature review also showed that most of the studies chose the student-centred approach in delivering the programme. In general, studies that used an appropriate student-centred approach and associated teaching strategies showed positive results in terms of an improvement in knowledge, attitudes and compliance on infectious disease and prevention practices (e.g., Calabro et al., 1998; Sokas et al., 1993; Uwakwe, 2000).

5.2.3 The need for change

Reflection on previous research on TB disease among HCWs is important to identify the most effective approach and methods to reduce the incidence of TB among HCWs. The significant finding that emerged from this reflection process is that the health education process on infectious disease and prevention was a neglected component of most HCWs' training (Affonso et al., 2004; Bennett & Mansell, 2004; Quah & Lee, 2004;

Twu et al., 2003; Wenzel & Edmond, 2003; Wurts, Dolan, O'Neal, & Azarcon, 1994). In addition, McCann and Sharkey (1998) reported that stigma and fear of contagion of infectious disease could be reduced significantly by health education intervention, both in education systems and in-service training.

According to Gordin, Willoughby, and Levine (1987), higher knowledge is associated with positive attitudes and behaviour among HCWs. Those with higher knowledge are more likely to agree to work in TB ward and clinics. These study findings emphasise the urgency to establish an effective health education programme for in-service training health education for HCWs.

Many researchers conducted research to evaluate KAP on infectious disease and prevention among HCWs; this is mainly because HCWs are considered as a high-risk group for infectious disease and risk of transmission of disease to high-risk patients under their care (Bellani et al, 1996; Bennett & Mansell, 2004; Chen et al., 2004; Lau et al., 2004).

5.3 Methodology

5.3.1 Research design

This was a randomised intervention study with a 1:1 allocation ratio to investigate the outcomes of a STEP programme. The participants received a pre-test at the beginning of the course (T1), a post-test at the end of the course (T2), follow-up test (T3) at one month after the course, and at three months after the course (T4).

5.3.2 Research settings

This study took place in Kedah state and the STEP was conducted in the main auditorium of the Sultanah Bahiyah Alor Setar General Hospital on 17th February 2016

5.3.3 Participants

5.3.3.1 Population

The study population was comprised of nurses in Kedah State from 9 hospitals and 56 health clinics. There are 6,247 nurses working government hospitals and health clinic in Kedah state. Nurses were selected as the population because they have had highest rate of TB among HCWs every year from 2011 to 2015 and they were among the highest in incidence and prevalence of TB among HCWs in Malaysia.

5.3.3.2 Sample and Sampling Method

Sample of this study consists of 600 nurses from Kedah state. Convenience sampling method was used to select the 600 samples for this study. Block randomisation method was performed to choose the intervention and control group among nurses in Kedah state. Randomisation minimises the chances for confounding and bias in intervention study design (Bland, 2000). The random allocation was made in blocks of four to keep the sizes of treatment groups similar. An advantage of small block sizes is that treatment group sizes are very similar.

Eligible criteria for the participants were nurses with one year of working experience, and exclusion criteria were nurses with a history of TB and less than one year of work experience.

5.3.3.3 Sample size

Only a limited number of research studies have evaluated the effectiveness of a health education programme on KAP on infectious diseases. However, most have chosen a cross-sectional study and, therefore, the sample size for this study was calculated based on a similar study design that assessed HCW's KAP towards HIV/AIDS (Uwakwe, 2000). The results of Uwakwe's (2000) study indicated a medium effect size, which according to Cohen (1992), meant there would need to be 164 subjects in each group to achieve a power of .80 with an alpha at .05. It is expected that 20% of all eligible people might refuse to participate and a further 30% might withdraw or be excluded from the

study. Thus, the sample was inflated by 20% (164 plus 32 per group) to account for refusals and attrition. Therefore, the minimum number of participants required in this study was approximately 200 nurses to ensure the study was adequately powered. A total of 300 nurses were thus recruited to the study for each group.

5.3.3.4 Block randomisation

Randomised-control trials are the gold standard study design for evaluating the effectiveness of a health education intervention study. The researcher estimates the impact of intervention through direct comparison with a randomly allocated control group that receives either no intervention or an alternative intervention. The randomisation process is the best way of ensuring that both known and (particularly importantly) unknown factors (confounders) that may independently affect the outcome of intervention are likely to be distributed evenly between the trial groups. As a result, differences observed between groups can be more confidently ascribed to the effects of the intervention rather than to other factors (Bland, 2000).

The randomisation sequence was created using Stat 9.0 statistical software with 1:1 allocation using random block sizes of 4. This method is designed to randomise subjects into groups that result in equal sample sizes and to ensure a balance in sample size across groups over time. Blocks are small and balanced with predetermined group assignments, which keeps the numbers of subjects in each group similar at all times. Blocks are then randomly chosen to determine the participant' assignment into the groups; those allocated to A were placed in the intervention group and B in the control group.

5.3.3.5 Recruitment process

Recruitment was based on discussion and collaboration with the head of department of OHU and the state matron in Kedah State Health Department. The Kedah State Health Department provided a list of 600 nurses who met the inclusion and

exclusion criteria for this study; this list included their name, workplace, identification number, and phone number. Convenience sampling method was applied to choose the 600 nurses. Subsequently the researcher arranged the name list based on alphabetical order to establish random allocation to reduce any bias in the distribution of participant characteristics in intervention and control group. Block randomisation was performed with Stata software by using the name list to ensure everyone had an equal chance to participate in this study. The researcher in collaboration with OHU and the State Nursing Unit contacted all the individuals chosen to explain this study. In addition, relevant information about the purpose of the study, the risks and benefits of participating, and information of a participant's right to autonomy and confidentiality were given in each participant in the form of an information sheet. Once the participant agreed, they were required to complete a consent form and returned it to the researcher. The sample was divided into two groups: category "A" or the intervention group, and "B" or the control group. A total of 277 of the 300 nurses randomised to the intervention arm consented and attended the programme. Meanwhile, 291 out of 300 participants agreed and consented to participate in the control group in this study. The respective healthcare facilities provided transportation facilities to bring the intervention participants to the main auditorium at Sultanah Bahiyah Alor Setar General Hospital on 17th February 2016.

5.3.4 Intervention programme (STEP)

The STEP programme was delivered based on a participant-centred approach that integrated demonstrations to motivate and apply KAP in clinical settings. These education activities included a series of lectures, videos presentations, hands-on demonstrations, and group discussions. Pre- and post-course assessment was performed by questionnaires distributed to participants prior to the course, immediately after the course (only for intervention group), one month after the course, and three months after the course for both intervention and control group to assess their KAP throughout the programme.

The session was comprised of eight hours of lectures and discussions focused on components of TB disease and prevention, including general information on TB, transmissions, diagnosis, investigation, treatment of TB disease, and preventive measures relatable to HCWs in Malaysia.

5.3.5 Research variables

There is one independent variable, three dependent variables, and six sociodemographic variables in this study.

5.3.5.1 Independent variable

The independent variable was the STEP. This included the nurses' test scores who did not participate in STEP programme (control group) and nurses who completed the full day education programme (intervention group).

5.3.5.2 Dependent variables

The three dependent variables in this study were healthcare workers' KAP as they relate to TB.

5.3.5.3 Demographic variables

In this study, demographic variables were obtained from self-reported data related to each participant's age, gender, workplace, education status, duration of job, and job status.

5.3.6 Potential confounders

Some potential confounders were identified through a comprehensive review of the relevant literature. These possible confounders were age, job category, working experience, and history of TB. Thus, these factors were taken into consideration in the demographic data to control and minimise the bias in the study.

The job category confounder has been controlled by selecting nurses only as participants in this study. The confounder for the history of TB is controlled by excluding

those nurses with the history of TB. Meanwhile, all other confounders were controlled by performing block randomisation.

5.3.7 Measurements and outcomes of STEP intervention

The outcome measurements from the STEP programme were nurses' KAP concerning TB prevention, which were measured by pre- and post-course. The questionnaire was prepared in English and Malay using simple language, in order to be an understood by all category respondents. This questionnaire was pre-tested, and reliability test has been done before this study among a group of respondents similar to the study sample in order to review the reliability. Demographics detailed important considerations about the participant that were thought to have a role in knowledge of and attitudes towards TB, such as age, gender, education, job, working experience, TB specific training, and disease status of participants.

The questionnaire consists of 87 items of knowledge (55 items), attitude (15 items), and practice (17 items). The reliability analysis showed that 39 out of 87 items of the KAP questionnaire sufficiently exhibited a measure of high internal consistency as their Cronbach's alpha values exceeded 0.7. The overall KAP domain showed a measure of good internal consistency of 0.8. These findings provided evidence to support the reliability of KAP questionnaire as an instrument that can be used in the future to determine the level of KAP of HCWs towards TB.

The knowledge section contained 15 questions divided into seven sections: general information on TB, signs and symptoms of TB, risk factors of TB, investigation on TB, treatment, and preventive control measures for TB. Answers were established as either “Yes”, “No”, or “Don’t Know”, but if a question was left unanswered it was considered “Don’t Know”.

Accordingly, the questionnaire was divided into six sections as follows:

Section A: Sociodemographic factors and general information

The respondents' sociodemographic variables, such as age, gender, the highest level of education, job grade, workplace, and job duration were collected. Respondents were asked whether they knew or heard of the disease TB and what sources of information they used to obtain information on TB. They were also asked whether they or any of their close contacts had a history of TB, such as neighbours, relatives, schoolmates. They were also asked whether they would visit a TB patient in their home.

Section B: Knowledge on TB

General awareness on TB was assessed by general inquiry information, symptoms, mode of spread and transmission, risk factors, diagnostic tests, treatment, and prevention. The questions on knowledge of TB were explored using simple lay terms for easy understanding.

Section C: Attitudes towards TB

Attitude refers to how a HCW views TB patients. A series of questions explored attitudes towards working with TB patients and their working environment related to how the respondent would react to various situations of personal contact with a TB patient and their assessment of their working environment.

Section D: Practices towards TB patients and preventive measures

Respondents were asked what course of action they would take in their workplace, personal prevention measures taken during working with TB patients, and the availability and usage of other preventive measures in their workplace.

Participants were assessed at 1 month and 3 months post intervention. Assessment at 1 month was chosen because this will assess the short-term memory retain of information from the intervention programme mainly on knowledge and attitude component, meanwhile 3 months assessment will assess the midterm memory retain of information and observe the changes of practice component mainly on TB prevention practices among participants. Ideally, it will be beneficial to assess the long-term impact

by reassess at 1 to 2 years post intervention to monitor the incidence of TB cases among HCWs in Malaysia. However due to time constrain, the researcher unable to assess the long-term impact or retain of information in this study.

5.3.8 Resource materials

PowerPoint slides and lecture notes were given to all participants after they completed immediate post-test for the intervention group. Meanwhile, control group participants received the lecture notes and PowerPoint slides after they completed the 3-month post-test or at any point of time when participants refused to continue further in this study for one month.

5.3.9 Ethical approval

Ethical approval for this study was obtained from the Medical Research and Ethics Committee of Ministry of Health Malaysia (MOH) (Reference Number: NMRR-15-913-24992 (Appendix A). The permission to conduct the study was also obtained from Disease Control Unit, Ministry of Health Malaysia. (Appendix B). Informed consent was also obtained from all participants, and ethical principles were preserved with strict adherence to confidentiality (Appendix F, G and H).

5.3.10 Data collection

The previously described questionnaire was used for data collection. The questionnaire was distributed to all participants before starting the programme in the morning and after completion of the full course for both pre-test and post-test data collection. These completed questionnaires were collected by the researcher before participants left the hall.

For the follow-up test, the questionnaires were distributed to our field representative from each workplace one week before the dateline for next data collection. The representative was expected to complete the data collection within one week upon distribution. The participants who received the questionnaire from the representative were

expected to complete the questionnaire at the time of distribution after which the representative collected them and compiled the questionnaire before sending the surveys to the Kedah State Health Department Occupational Health Unit for final compilation. Next, the researcher collected the questionnaires for data entry, cleaning, and analysis. The particular period of the study and intervals between testing for data collection were one month and three months after the STEP programme. Participants who refused to continue to be in this study for follow-up were thanked for their time and no further follow-up occurred for these participants.

5.3.11 Scoring

Sociodemographic

The sociodemographic data consisted of age, gender, level of education, hospital, job grade, workplace, and duration of the job collected in the form of nominal and ordinal levels of measurement.

Knowledge

The knowledge domain included items on TB that covered general knowledge, symptoms, risk factors, diagnostic tests, treatment, and prevention of the disease. There were 55 items in this domain with the option of answering "Yes", "No", and "Don't Know". The scoring of the items was numerical where the correct answer was given two points, wrong answers received zero, and "Don't Know" got one point (Doshi et al., 2012). The items then were re-coded into two categories: correctly chosen answers and incorrect or "Don't Know" answers (Nkulu et al., 2010). The range for a total score of knowledge was between 0 and 110 points.

Attitude

The attitude domain consisted of statements that revolved around respondents' reactions towards disease prevention as a HCW. There were 17 items in the attitude domain scored on a 5-point Likert scale ("Strongly Agree", "Agree", "Not Sure", "Do Not

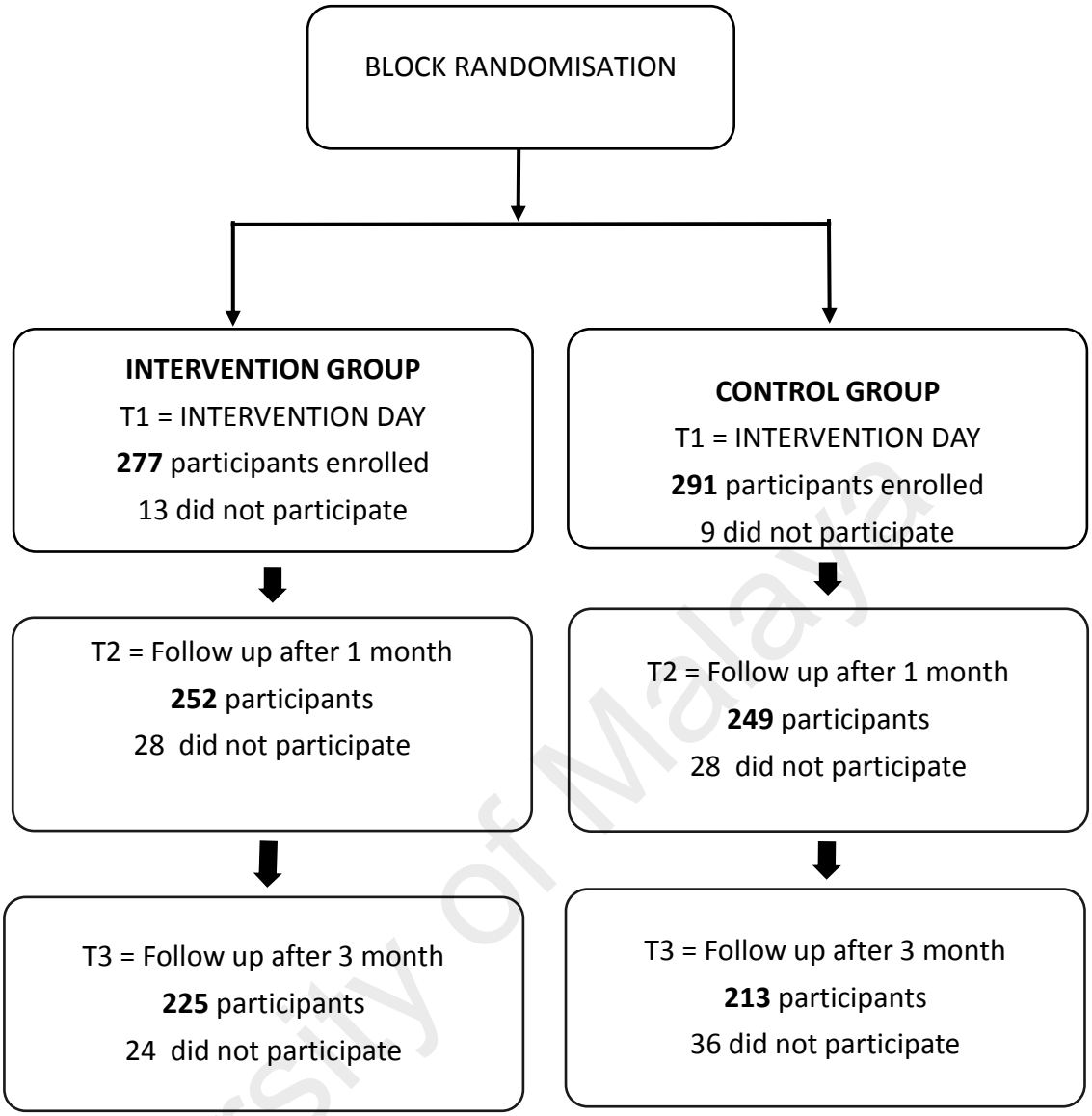
Agree", and "Strongly Disagree"). A maximum score of five was given to the most positive/tolerant response, whereas the minimum score of one point was given for the most negative response (Jain et al., 2010). In identifying a positive or negative attitude, the five-point Likert scale was collapsed into two categories; agreement (strongly agree, agree) versus disagreement (not sure, do not agree, strongly disagree) (Kiefer et al., 2009). Total possible scores ranged from 17 to 85 points. Those with total scores equal or below the mean were considered to have a negative attitude, whereas those above the mean score were considered to have a positive attitude (Nkulu et al., 2010).

Practice

The practice domain included 15 questions on prevention control measures towards TB answered on a 5-point Likert scale ("Always", "Often", "Sometimes", "Seldom", and "Never". A maximum score of five was given to the correct answer, whereas the minimum score of one was given for the wrong answer. The total possible score ranged from 15 to 75 points. Total scores equal or below the mean reflected poor practice and good practice was reflected by total scores above the mean.

Bloom's criteria.

Total mean score of KAP were divided into three categories: knowledge was divided into high, moderate, and low; attitude was divided into positive, neutral, and negative attitude; and practice was divided into good, neutral, and poor practice. These three categories of high, moderate, and low were categorised based on the Blooms criteria scoring system. A high score was 80% and above, a moderate score was from 60% to 79%, and a low score was less than 60%.



5.3.12 Data cleaning

The questionnaire was pre-coded for entry and analysed using SPSS Statistics software (Version 21). To minimise the data entry errors, data check codes were organised into the database and the data cleaning was done to increase the quality of the data. Questions that were left unanswered and empty from the questionnaire were left empty during data entry and treated as missing data. The researcher contacted the participants to ask the unanswered questions over the phone for all the missing data before proceeding with data analysis. There were no missing data in final compilation before proceeding

into data analysis in this study. The researcher successfully obtained all answers from the participants who completed this study.

5.3.13 Data Analysis

All data were managed, summarised, and analysed using SPSS version 21 and Stat statistical software. All raw data were cleaned and checked for accuracy and consistency by examining the frequencies for each variable (LoBiondo-Wood & Haber, 2002; Polit & Beck, 2004). Several types of statistical analyses were conducted to examine the relationship and association between the variables. Firstly, a test to determine normal distribution was performed. Descriptive statistics described and summarised the data by applying the techniques of frequency distribution, Mean (M) or Median (if the data were skewed or abnormally distributed), and SD or range in order to gather the average of the sample characteristics, to assess the accuracy of the data set (LoBiondo-Wood & Haber, 2002; Polit & Beck, 2004).

All underlying assumptions regarding the statistical methods were examined prior to the univariate, bivariate, and multivariate analyses. Statistical significance was reported at the conventional p-value of equal to or less than .05 level (two-tailed) with 95% CI. The analytical approaches that were used in this study are summarised in Table 5.1 and discussed further based on the research questions and hypotheses defined.

Data analysis for knowledge, attitude and practice scores obtained from questionnaire assessment were assessed based on continuous data and categorical data. The mean scores of the results of KAP were obtained for continuous data analysis meanwhile, KAP mean scores were categories based on Bloom's criteria or Bloom's cut of point. In view of categorical data analysis, the mean scores of KAP from continuous data were converted into percentage, subsequently the percentage scores were converted into three categories based on Blooms criteria: high (≥80%), moderate (61%–79%), and

low (≤60%). Blooms criteria was originally used in academic scoring system to differentiate between 3 categories which consist of high with achievement of 80.0%–100.0% of total scores, moderate category with achievement of 60.0%–79.0% of total scores and low categories with achievement of ≤59.0% of total scores. The original Bloom's criteria or Bloom's cut-off points, 80.0%–100.0%, 60.0%–79.0%, and ≤59.0%, were adapted and modified from the KAP study conducted on dengue fever prevention among the people of Male', Maldives and Bangkok in 2007 (Nahida A., 2007). They were used to classify KAP into three levels which is high, moderate and low.

Table 5.1: The statistical methods utilised for the intervention study.

Outcome variables (DV)	Explanatory variables (IV)	Univariate/ summary statistics	Bivariate/ homogeneity comparison	Multivariate analysis
Continuous	Continuous	Mean (SD)	--	--
	Dichotomous	Number (%)	Paired *t*-test	Linear mixed model
	Categorical	Number (%)		
Categorical	Dichotomous	Number (%)	Chi-square (χ^2)	Linear mixed model
	Categorical	Number (%)		

Univariate analysis

Descriptive statistical analyses were conducted to determine demographic variables: age, gender, education level, job duration, workplace, family history of TB, friends with TB, history of visiting family/friends with TB. The mean and SD for a continuous variable (age, job duration) and the count the percentages for the dichotomous or categorical variables (gender, education level, workplace, family history of TB, friends with TB, history of visiting family/friends with TB) were calculated.

Homogeneity between the two groups (the control and intervention groups) was assessed with the chi-square test to determine the differences between the independent and dependent variables for categorical and dichotomous variables. The assumptions underlying chi-square analysis were: a) each subject may contribute only one response to

the contingency table; and b) the number of responses obtained should be large enough so that no expected frequency is less than 10 in a 2×2 contingency table or less than 5 in a contingency table larger than 2×2. If these conditions were not met, then an alternative, such as the Fisher exact test was used to improve the validity of the result (Green & Salkind, 2005; Huck, 2004). Chi-square analysis was performed to evaluate the difference between the intervention and control groups with these following variables: age, gender, education level, job duration, workplace, family history of TB, friends with TB, history of visiting family/friends with TB. The t-test was used to test the differences between the intervention and control groups when the variables were continuous data in nature, such as age and KAP. The assumptions underlying the t-test analysis were: a) independence of observation; b) dependent variables were normally distributed; and c) equal variance (Green & Salkind, 2005; Huck, 2004). The t-test was conducted to evaluate the differences between groups with the demographic variable (age) and baseline outcome variables (knowledge, attitude and practice). If the significance of these two tests was equal to or less than .05 ($p \leq .05$), there was a significant difference between the intervention and control groups. In addition, if the variable in the t-test analysis indicated a significant unequal variance (Levene's test for equality of variance, $p < .05$), the result for the 'equal variances not assumed' were reported to reach the validity of the test (Green & Salkind, 2005; Huck, 2004).

5.3.13.1 Hypothesis testing

The three hypotheses were tested utilising linear mixed modelling (LMM). A repeated measure multivariable analysis using LMM was undertaken to examine the changes in outcome variables between the intervention and control groups over time, and associations between the outcome variables and multiple independent variables. LMM was undertaken as it provided a general and flexible approach accounting for correlation of measurements over time as well as covariance structures (West, 2009). It allowed

analysis to be performed based on the number of participants who were intended to be part of the final sample (intention to treat) rather than on the basis of the number of participants who completed the study. Therefore, by using LMM in this study, bias due to participant attrition or noncompliance could be minimised. However, prior to undertaking the LMM, the data format was restructured to "vertical or long format". This restructuring resulted in the data table having one row per participant per measurement of time so that a repeated measure LMM could be performed. Given each participant was assessed at three time-points, there were three data rows for each participant following the restructuring (West, 2009).

The researcher tested separate models for KAP on TB (dependent variables) within each group (intervention and control). The focus of this analysis was on the changes in scores over time and it was thought that there would be differences in the mean for both outcome variables over time but that this difference would be dependent on the group. Time (3 levels), group (2 levels), and time*group were entered as fixed factors into the model. Time (3 levels) was also added as the repeated measure. To allow for clustering, the clinical area was added as a random effect.

The models tested included covariates and factors collected from baseline data collection. It was hypothesised that there would be specific baseline characteristics that could influence outcome scores from the participants. The model, with KAP as the outcome variable, included the independent variables of age, gender, job duration, workplace, education level, family history of TB, and friends with TB.

5.4 Results

Table 5.2 shows the baseline characteristics of participants who completed this study compared with those who did not. A descriptive and comparative analysis of baseline characteristics of the participants was conducted to identify the differences present among participants between both groups. This comparison was performed to identify whether the participants recruited and retained were a true representation of the study population. A total of 438 out of 568 participants completed the study (77% retention). Independent two-sample t-test analyses were performed to compare means of participants who completed versus participants who did not, and the assumption of normal distribution was met. It is confident to say that both completers and non-completers had similar characteristics. The mean age of the sample from both groups was approximately 35 years and the majority of participants from both groups were female and completed STPM or Diploma level of education. Job duration between both groups was also similar with approximately 11 years working experience. The majority of the participants in both groups did not have a family history of TB and friends with TB disease; hence, most of them did not have a history of visiting family and friends with TB. Further, 50% of participants felt that their level of KAP of TB prevention was not sufficient to prevent TB. In conclusion, there is no difference in baseline characteristics between completers and non-completers in this study; this provides information that there is no evidence of emigration selection bias of participants in this study.

Table 5.2: Baseline characteristics by completers and non-completers of all visits.

Variable	Overall n (%)	Complete n (%)	Didn't complete n (%)	P–value
Age*	35.63 ±7.96	35.83 ±8.2	35.12 ±7.098	0.338
Gender				
Male	17 (100)	15 (88.2)	2 (11.8)	0.243
Female	551 (100)	423 (76.8)	128 (23.2)	
Education Status				
SPM	112 (100)	97 (86.6)	15 (13.4)	0.211
STPM/Diploma	446 (100)	331 (74.2)	112 (25.8)	
Degree	9 (100)	9 (100)		
Masters/ PhD	1 (100)	1 (100)		
Workplace				
Hospital	252 (100)	182 (72.2)	67 (27.8)	0.067
Clinic	316 (100)	256 (81.0)	60 (19.0)	
Job duration*	11.6±3.4	11.8 ±7.6	11.2 ±6.6	0.341
Family Hx TB				
Yes	60 (100)	48 (80)	12 (20)	0.596
No	495 (100)	379 (76.6)	113 (23.4)	
Do not know	13 (100)	11 (84.6)	2 (15.4)	
Friends with TB				0.817
Yes	119 (100)	89 (74.8)	24 (25.2)	
No	405 (100)	310 (76.5)	95 (23.5)	
Do not know	49 (100)	37 (75.5)	8 (24.5)	

Table 5.2, continued

Hx of visiting Family/friends with TB				0.601
Yes	61 (100)	41 (67.2))	18 (32.8)	
No	293 (100)	235 (80.2)	58 (19.8)	
Not sure	214 (100)	163 (76.2)	51 (23.9)	
Opinion				
Yes	296 (100)	226 (76.0)	70 (24.0)	0.634
No	199 (100)	155 (77.9)	42 (21.1)	
Not sure	73 (100)	57 (78.1)	16 (21.9)	

* age and job duration summarised as mean±SD

Based on block randomisation, 600 participants were randomised: 300 participants were randomised to the intervention group and 300 participants to control group. However, at baseline, 277 participants in the intervention group and 291 participants in the control group were participating in this study. Although the groups were randomly assigned and were assumed equivalent, the homogeneity of the groups was re-examined to demonstrate that randomisation was still effective (Table 5.3). Additionally, it was important to compare the baseline characteristics between the two groups as a cluster randomisation procedure to determine any imbalances between the two groups. If imbalances were obvious, then further considerations would have been necessary for final analyses, as adjustments for their effects may have been necessary (Kirkwood & Sterne, 2007).

The 277 participants in the intervention group were not significantly different ($p < 0.05$) from the total of 291 participants in control group based on gender, job duration, highest education level, and workplace. As shown in Table 5.3, the statistical analysis showed that there was a difference between the two groups in terms of age, a family

history of TB, friends with TB, and history of visiting family or friends with TB. Although the difference in age between both groups was statistically significant, it was not considered clinically significant because the participants in the intervention group were only 1.5 years younger than the control group on average.

Table 5.3: Baseline characteristics by randomization assignment.

Variable	Intervention group (n = 277)	Control group (n = 291)	P-value
Age*	34.88 ±7.8	36.35 ±8.0	0.03
Gender			0.14
Male	5 (1.8)	12 (4.1)	
Female	272 (98.2)	279 (95.9)	
Education level			0.17
PMR/SPM	54 (19.5)	58 (19.9)	
STPM/Diploma	221 (79.8)	225 (77.4)	
Degree	1 (0.4)	8 (2.7)	
Master/PhD	1 (0.4)	0 (0)	
Job duration*	11.14 ±7.4	12.05 ±7.4	0.15
Workplace			0.39
Hospital	128 (46.2)	149 (53.8)	
Clinic	124 (42.6)	167 (57.4)	
Family Hx TB			
Yes	38 (13.7)	22 (7.6)	0.03
No	235 (84.8)	260 (89.3)	
Don't Know	4 (1.4)	9 (3.1)	
Friend with TB			
Yes	64 (23.1)	50 (17.2)	0.03
No	198 (71.5)	211 (72.5)	

Table 5.3, continued

Don't Know	15 (5.4)	30 (10.3)	
Hx visiting family/friends with TB			0.02
Yes	30 (10.8)	15 (5.2)	
No	229 (82.7)	248 (85.2)	
Not sure	18 (6.5)	28 (9.6)	
Opinion on sufficient KAP			0.01
Yes	161 (58.1)	135 (46.4)	
No	94 (33.9)	105 (36.1)	
Not sure	22 (7.9)	51 (17.5)	

* age and job duration summarised as mean±SD

A paired-samples t-test was conducted to compare mean KAP scores on pre-test (before STEP programme) and first post-test (immediately after STEP programme) (Table 5.4). Based on knowledge scores, there was a significant difference in the scores for pre-test (M = 89.72, SD = 6.06) and immediate post-test (M = 101.03, SD = 3.86), p = <0.001. These results suggest that participants' knowledge scores in the intervention group improved significantly after completing the STEP programme. Meanwhile, for attitude scores, there was a significant difference in the scores for pre-test (M = 58.9, SD =5.88) and first post-test (M = 67, SD = 4.57), p = <0.001. These results suggest that participants' attitude scores also improved significantly after completing the STEP programme. Finally, practice cores showed there was no significant difference in the scores between pre-test (M = 65.9, SD = 5.88) and immediate post-test (M = 66.2, SD = 4.57), p = 0.612. These results suggest that participants' practice scores did not improve immediately after completing the STEP programme and the practice mean scores were similar pre- and post-test.

Table 5.4: Comparison of KAP scores between immediate post-test and baseline scores intervention group.

Variable	Mean score	P value
Knowledge		≤0.001
Pre-test	89.72 ± 6.06	
Post-test	101.03 ± 3.86	
Attitude		≤0.001
Pre-test	58.85 ± 5.88	
Post-test	67.04 ± 4.57	
Practice		0.612
Pre-test	65.9 ± 6.48	
Post-test	66.16 ± 5.74	

The linear mixed model analysis was done to assess the differences in the mean scores across the three points (pre-test, one month follow-up test, and three months' follow-up test) in the intervention and control groups. The results showed that the knowledge scores in the control group did not significantly improve over time and the difference in the mean score was small compared to the intervention group (Table 5.5). The intervention group had a significant improvement in mean score over time after the STEP programme. Attitude mean scores for TB in the intervention group significantly increased over time after the STEP programme. However, there was no difference in mean score between 1-month versus 3-month post-test. These results showed that the attitude scores for TB in the intervention group significantly increased and improved over time after the STEP programme, except between 1-month and 3-month post-test. Practice scores for TB in the intervention group significantly increased over time only at the one-month post-test and the 3-month follow-up post-test means scores were comparative to

the baseline. These results indicate that there are no changes in mean practice scores for TB in control group across time.

Table 5.5: TB KAP scores comparing intervention and control at baseline, 1 month, and 3 months.

Variable	Group	Pre-test	Post 1month	Post 3 month	p-value
Knowledge	Intervention	90.1±5.8	99.2±2.3	98.6±2.9	<0.001
	Control	90.5±6.9	91.7±5.6	93.3±5.2	
Attitude	Intervention	58.9±6.4	68.0±6.9	68.6±4.2	<0.001
	Control	58.2±7.2	58.7±4.3	59.8±6.2	
Practice	Intervention	65.9±6.7	67.0±5.6	67.3±5.0	<0.001
	control	65.3±5.3	65.2±5.0	63.5±4.8	

Table 5.6 shows the proportion of high knowledge, positive attitude, and good practice stratified by intervention and time. Immediately after the STEP programme (time 0), only one participant (0.4%) scored in the low/moderate category for knowledge in TB and the remaining 276 (99.6%) scored in the high knowledge category. Meanwhile, at baseline, only 65.6% of the participants in the control group scored in the high knowledge category and 34.4% scored in low/moderate knowledge category. The percentages of the high knowledge category continued to plateau between 99% and 100% throughout the three months following the STEP programme. Meanwhile, the percentages of participants scoring in the high knowledge category increased slightly from 65.6% to 80.3% after three months in the control group. However, the percentage of participants who scored in the low knowledge category in the control group remained at approximately 20% compared with 0.9% for the intervention group at three months.

At baseline, the majority of the participants in the control group (93.5%) and almost two-thirds of participants in the intervention group (66.4%) scored in the neutral or negative attitude category. There was an improvement in the intervention group at the

one-month post-test with an increase of participants scoring in the positive attitude category (from 33.6% to 47.8%). However, a slight drop occurred at three months post-test (45% of participants scored in the positive attitude category). In general, there was an increase in the number of participants scoring in the positive attitude category after the STEP over time in the intervention group. Meanwhile, there was no improvement in the control group, as the majority remained in the negative or neutral attitude category from baseline to 3-months follow-up test (93% and 97 %, respectively).

Regarding practice, 78% of participants demonstrated good practice in both the intervention and control groups. This finding was similar to the previous cross-sectional results in Chapter 3 that showed 79.5% of nurses across 11 states in Malaysia had good practice concerning TB prevention. However, there was no improvement in practice after one month and only a slight improvement at three months with an increase of 11% of participants scoring in the good practice category compared to time 0. No improvement in good practice was seen in the control group from baseline to 3-month post-test

Table 5.6: Proportions of high knowledge,positive attitude, and good practice stratified by intervention and time.

Variable	STEP			CONTROL		
	Time (month)			Time (month)		
	0	1	3	0	1	3
Knowledge						
Low/moderate	1 (0.4)	0 (0)	2 (0.9)	100 (34.4)	79 (31.4)	42 (19.7)
High	276 (99.6)	249 (100)	223 (99.1)	191 (65.6)	173 (68.7)	171 (80.3)
Total	277	249	225	291	252	213
Attitude						
negative/neutral	184 (66.4)	130 (52.2)	124 (55.1)	272 (93.5)	237 (94.0)	207 (97.2)
Positive	93 (33.6)	119 (47.8)	101 (44.9)	19 (6.5)	15 (6.0)	6 (2.8)
Total	277	249	225	291	252	213
Practice						
Poor/neutral	61 (22.0)	47 (18.9)	23 (10.2)	66 (22.7)	47 (18.7)	33 (15.5)
Good	216 (78.0)	202 (81.1)	202 (89.8)	225 (77.3)	205 (81.4)	180 (84.5)
Total	277	249	225	291	252	213

Table 5.7 shows the association of the STEP programme with KAP scores. Results indicate that knowledge scores have been positively influenced (β =10.43) with the implementation of the STEP programme, and after one month of the programme, the knowledge scores continued to be positively influenced (β = 0.123). The interaction between the STEP programme and time, however, has negatively influenced knowledge score (β = -1.57). Similar to knowledge, attitude scores have been positively influenced (β = 9.26) with the implementation of the STEP programme. After one month of the

programme, the attitude scores remained positively influenced (β = 0.51). The interaction between the STEP programme and time, however, has negatively influenced attitude score (β = -0.01). Practice scores have been positively influenced (β =1.78) with the implementation of STEP programme and continued to be positively influenced after one month (β = 0.21). However, unlike knowledge and attitude, practice scores remained positively influenced over time (β = 0.19).

Table 5.7: Longitudinal association of STEP and KAP scores.

Variables	β (95% CI)	P–value
Knowledge scores		
Control	(ref)	
STEP Programme	10.43 (9.67 to 11.20)	<0.001
Time (1-month)	0.123 (-0.01 to 0.25)	0.005
STEP*time (month)	-1.57 (-1.80 to -1.35)	<0.001
Attitude scores		
Control	(ref)	
STEP Programme	9.26 (8.37 to 10.15)	<0.001
Time (1-month)	0.51 (0.39 to 0.62)	<0.001
STEP*time (month)	-0.01 (-0.24 to 0.23)	<0.001
Practice scores		
Control		
STEP Programme	1.78 (0.97 to 2.6)	<0.001
Time (1-month)	0.21 (0.07 to 0.36)	0.004
STEP*time (month)	0.19 (-0.10 to 0.48)	<0.001

Table 5.8 shows the effects of the association of the STEP programme with high knowledge, positive attitude, and good practice scores. Results indicate that high knowledge was positively influenced (β = 2,199.8) with the implementation of the STEP programme and remained positive after one month (β = 1.64). The interaction between the STEP programme and time has positively influenced high knowledge (β = 0.34). Positive attitude was also positively influenced (β = 77.8) with the implementation of the STEP programme and remained positive after one month (β = 1.13). Similar to high knowledge, the interaction between the STEP programme and time has positively influenced positive attitude scores (β = 2.00). Last, good practice was also positively influenced (β = 1.06) with the implementation of STEP programme and remained positive after one month (β = 0.21). The interaction between the STEP programme and time also positively influenced good practice scores (β = 0.19).

Table 5.8: Longitudinal association of STEP programme and high knowledge, positive attitude, and good practice.

Variables	Odds Ratio (95% CI)	P–value
High Knowledge		
Control	(ref)	
STEP Programme	2199.8 (263.5 to 18367.3)	<0.001
Time (1-month)	1.64 (1.32 to 2.02)	<0.001
STEP*time (month)	0.34 (0.12 to 0.96)	<0.001
Positive Attitude		
Control	(ref)	
STEP Programme	77.8 (32.8 to 184.7)	<0.001
Time (1-month)	1.13 (0.99 to 1.30)	<0.001
STEP*time (month)	2.00 (1.33 to 3.00)	<0.001

Table 5.8, continued

Good Practice		
Control	(ref)	
STEP Programme	1.06 (0.58 to 1.93)	0.850
Time (1-month)	1.35 (1.17 to 1.57)	<0.001
STEP*time (month)	1.22 (0.91 to 1.64)	0.180

5.5 Discussion

This chapter outlined the data analysis evaluating the effect of the STEP education programme on HCWs' ability to improve their KAP on TB. The STEP education programme was developed from a range of sources (literature review, Malaysian Clinical Practice, and US CDC guidelines) and implemented to examine the improvement of HCWs' KAP. Even though the introduction of the intervention did improve HCWs' level of knowledge and attitude, it did not significantly improve practice on TB. It will be argued that although statistically significant, the effect size is small, which makes a small impact on the level of practice on TB in the intervention group. A slight improvement was only seen after three months in the intervention group, whereas in the control group, there was no significant improvement in practice throughout the study.

This study has methodological strengths that have improved on those used in prior research in the field. This study was the first of its kind to examine an intervention to improve HCWs' ability to understand facts, myths, and misunderstandings in TB disease and demonstrate proper practice to prevent TB disease. Moreover, this STEP was based on sound educational principles and learning theory.

5.5.1 Effectiveness of the STEP programme

To evaluate the effectiveness of STEP programme to improve KAP on TB among HCWs, three hypotheses were examined. The discussion based on these three hypotheses is presented in the following sections.

5.5.1.1 Effectiveness of the STEP programme on knowledge

Hypothesis One: HCWs who participated in STEP programme will have higher scores on knowledge on TB than the HCWs who did not receive the programme.

The STEP programme was expected to improve knowledge scores on TB and overall, the mean knowledge scores on TB in the intervention group were significantly higher than the control group. The knowledge scores for the intervention group consistently improved over the three time-points. Although the control group did show a slight increase in knowledge over the 3-month period, it was only a difference of three units in mean score compared to the baseline score. An increase over time is possible due to repetition of questions, which may have meant the control group was able to memorise the correct answer by the second post-test. This result was consistent with other similar studies that evaluated the effectiveness of health education intervention on knowledge improvement towards disease-related or infection control among HCWs (Calabro et al., 1998; Diekema et al., 1995; Jeffe et al., 1999; McCann & Sharkey, 1998; Uwakwe, 2000; Wang et al., 2003).

Six analogous papers were published that focused on the effectiveness of educational programmes for improving HCWs on infectious disease and infection control between 1995 and 2003 (Calabro et al., 1998; Diekema et al., 1995; Jeffe et al., 1999; McCann & Sharkey, 1998; Uwakwe, 2000; Wang et al., 2003). These studies showed a significant improvement in HCWs' knowledge on universal precautions compared to a control group. McCann and Sharkey (1998) evaluated a health education intervention based on a problem-based learning (PBL) approach. They evaluated knowledge on

HIV/AIDS infection and precautions among nurses and found that there was a significant improvement in knowledge scores among nurses in the intervention group compared to the control group. This result was also evident in a replicated study conducted in Nigeria (Uwakwe, 2000).Furthermore, a recent similar study by Wang et al. (2003) in China documented similar findings on knowledge of universal precaution on infection disease among nurses.

The results of this study indicate that baseline knowledge of TB is similar in both intervention and control groups with a mean score of 90.1±5.8 and 90.5±6.9, respectively. After the STEP programme, there was a significant increase in knowledge mean scores in the intervention group with 101.03±3.9. Therefore, there was an immediate positive effect of the STEP programme concerning knowledge on TB. This can be considered as short-term or immediate memory improvement.

Further assessment after one month of intervention investigated the midterm memory or medium-term memory retention of knowledge on TB after the STEP, showed there was a slight drop in knowledge score from 101.03±2.3 to 99.2±2.3. However, despite a slight drop, the mean score is significantly much higher compared to the control group (91.7±5.6). This shows that the medium-term retention of knowledge on TB among participant after the STEP is impressive.

Finally, after three months, reassessment results showed that the mean score was almost similar to that of post-test one in the intervention group. This indicates no fluctuation or instability in the results in the intervention group and that a plateau or saturated line was reached, which reflects that it has reached the maximum impact from the STEP programme.

However, there was a slight improvement in the control group with a total of three units from the baseline mean score, even though statistical analysis showed the difference is significant, based on practicality, the difference was too small to consider as an

improvement in knowledge. Therefore, the results of this study agree with those found in similar literature studies.

High knowledge categories in both the intervention and control groups at baseline were 63.5% and 65.6%, respectively. This finding was slightly higher than the cross-sectional study with 55.8%. Participants in the intervention group showed significant improvement whereby high knowledge categories increased to 99.6% with only one participant in the moderate category. This improvement was maintained throughout the study period. Meanwhile, there was a slight improvement in the control group from 65.6% to 80.3%. However, this might be due to familiarisation of questions by the participants over time. Nevertheless, the results showed that the STEP programme was very effective in improving knowledge on TB disease and prevention among HCWs in Malaysia.

5.5.1.2 Effectiveness of the STEP programme on attitude

Hypothesis Two: HCWs who take part in the STEP programme will have higher scores on attitude concerning TB than HCWs who did not receive the programme.

This designed education programme was expected to improve attitude scores on this topic. In general, the average attitude scores on TB in the intervention group were significantly increased over three months compared with the control group. The scores for the intervention group consistently improved over the three time-points. This result was consistent with other studies that have tested the effectiveness of attitude improvement via an educational intervention of other disease-related or infection control among HCWs (Calabro et al., 1998; Diekema et al., 1995; Jeffe et al., 1999; McCann & Sharkey, 1998; Uwakwe, 2000; Wang et al., 2003).

The results of this study showed that attitude mean score of TB at baseline was similar between the intervention and control groups with a mean score of 58.9±6.4 and 58.2±7.2, respectively. After the STEP programme, there was a significant increase in attitude mean score among the intervention group (67.04±4.6). This showed the

immediate effect of STEP programme improves participants' attitude on TB prevention. This can be considered as short-term or immediate memory improvement. Meanwhile, further assessment after one month of intervention showed a continuation of improvement in attitude mean score to 68.0±6.9. However, there was no improvement in mean attitude score in the control group. Results confirm good medium-term retention of knowledge on TB among participants after the STEP.

Finally, after three months, reassessment results showed that the mean score was almost similar to the mean score of post-test one in the intervention group. This indicates no fluctuation or instability in results in the intervention group and that they have reached a plateau or saturated line, which reflect that it has reached the maximum impact from the STEP programme. Meanwhile, there was no improvement in the control group from a baseline mean score. Therefore, the results of this study agree with those found in similar literature studies, and that the STEP programme was effective in improving attitude on TB disease and prevention among HCWs in Malaysia.

Positive attitude categories in both the intervention and control groups at baseline were 5.1% and 6.5%, respectively. This finding was slightly lower than findings from the cross-sectional study with 7.2%. Participants in the intervention group showed significant improvement whereby positive attitude categories increased to 45% or six times greater than baseline scores. The study showed there was a progressive increase in positive attitude over the months after the intervention programme and this improvement was maintained throughout the study period. Meanwhile, there was a slight drop in the control group from 6.5% to 2.8%.

The belief that TB spreads easily affects the attitudes of the participants towards TB patients. In the current study, the most common response by participants for the avoidance of TB patients was due to the fear of being infected, which has also been widely reported by other studies (De Stigter et al., 2000; Jones et al., 1984; Withington et al.,

2003). The current study also found that the perceived modes of transmission also contributed to negative attitudes, which were significantly higher among the participants at baseline who believed that TB was difficult to treat and held the misconceptions that TB patients "should not attend social functions", "should quit their job", and "avoid marriage". Baseline results indicated that HCWs would refuse to work in TB clinics and train as TB HCWs in fear of being possibly placed in a TB-related ward or clinic as their workplace. However, after completion of the STEP programme, intervention group participants had better attitudes towards TB, has been identified by the present study when they responded favourably to being motivated and willing to work in a TB-related workplace.

5.5.1.3 Effectiveness of the STEP programme on practice

Hypothesis Three: HCWs who participate in the STEP programme will have higher scores on practice concerning TB prevention than the participants who did not participate in the programme.

This research study provides an important contribution to practice on TB prevention. Practice is defined as the ability to properly choose and apply infection precautions and equipment to prevent TB infection in a specific clinical scenario or environment. The reason for investigating this issue is to reinforce HCWs' clinical skills in applying scientific knowledge and to ensure they are able to apply skills in the clinical field. The results of the present study showed that this education programme did not effectively improve practice on TB prevention in comparison to the control group. However, despite a statistically significant improvement within the intervention group at three months compared to baseline, the differences were only two units.

Good practice categories in the intervention group (81.9%) were slightly higher compared to control group (77.3%) at baseline. However, this finding was almost similar to a cross-sectional study finding with 79.5% of nurses scoring in the good practice

category. Participants in the intervention group showed a slight improvement, whereby participants in the good practice category had increased by 12% from the baseline. However, the improvement was noted only after three months post-intervention and there was no improvement immediately post-intervention or at one month.

The STEP programme thus reinforced HCWs' ability to apply good practice on TB prevention. The increase only after three months could be because practice is categorised as a sophisticated level of education, which may be difficult to improve upon in a short time. In this case, the skills level or practice level can be fostered and strengthened after constant awareness following the education programme or it may simply take a longer time to see the effectiveness of the programme.

CHAPTER 6: CONCLUSION

The cross-sectional study in this research project addressed two keys research questions. The first aim was to assess the current level of KAP and identify the association between occupation and KAP on TB prevention among HCWs in Malaysia. The results of this study and their significance are presented in the following sections.

This was the first study examining KAP on TB prevention. The results showed that only 55% or slightly more than half of total participants for all four job statuses have high knowledge on TB prevention, whereby less than 10% have positive attitude and 75% have good practice on TB prevention. This shows that current practice is quite impressive with the majority of HCWs demonstrating good practice. However, there is room for improvement. For instance, more attention is needed to improve knowledge and, more importantly, to improve HCWs' attitude towards TB disease and prevention.

Based on job statuses, health attendants require immediate action to improve their KAP because despite being the front liner in healthcare facilities, they had the lowest percentage of high knowledge, positive attitude, and good practice compared with other job statuses.

This study thus provides an important baseline measure of the level of KAP on TB disease and prevention. The findings imply that a standard programme focusing on KAP on TB should be implemented and incorporated into the HCWs' training programme on a regular basis to produce a competent and autonomous healthcare professional who has good knowledge, a positive attitude, and good practice on TB disease and prevention.

Meanwhile, the health education intervention study is essential because it is the first research to assess the effectiveness of an Tuberculosis health education programme on healthcare workers in Malaysia, specifically on KAP in tuberculosis disease and prevention. The effectiveness of the STEP was measured by the mean score differences

and categorical based on blooms' criteria between the intervention and control groups on the variables of knowledge, attitude and practice on tuberculosis disease and prevention.

In general, the results of the study suggested that the STEP program effectively and significantly improved knowledge, attitude and practice among participants compared to the control group.

However, when time factor taken into consideration, STEP did not significantly have immediate improvement in practice on tuberculosis within 1-month post intervention. However, we can see the improvement after 3 months.

This finding could have been due to changes of an individual's behaviour and practice requires more time to adapt to new changes of practice and usually it will be progressive and the outcome of their practice only can be seen after few months.

Overall, the STEP had a positive impact on KAP on tuberculosis disease and prevention. Throughout the three months following the implementation of STEP, result indicated that the program benefited healthcare workers. It can thus be stated that STEP program was proved to be effective with sustainable effects, as there was a consistent improvement on every outcome variable, namely knowledge, and attitude.

This study showed that almost 75% of HCWs in Malaysia demonstrated good practice and nurses accounted for the highest percentage of good practice scores. This may prove that the current practice of disease prevention is well-equipped and trained mainly among nurses in Malaysia compared to similar findings from other parts of the world. Further, the improvement of practice also depends on other external factors, such as training frequency by employers and supply of PPE.

6.1 Administrative control measures

6.1.1 A limited supply of PPE

The practice of wearing PPE, such as aprons and N95 masks were asked in questions related to practice on TB, as inadequate or limited supply of this protective equipment in the workplace can lead to poor practice. This is not necessarily due to HCWs, but rather that the employer failed to supply adequate and proper protective equipment to their employee. This is mainly the responsibility of the employer according to Occupational Safety and Health Act 1994 in Malaysia, whereby the employer is responsible and must ensure their employees work in the healthy and safe environment by taking proper control measures, including providing and training on the proper application of PPE.

6.1.2 Training activities by employer

The frequency of training activities concerning TB, such as courses, seminars, or other related training, were asked in questions related to practice on TB. Again, this is the responsibility of employer according to Occupational Safety and Health Act 1994 in Malaysia, whereby the employer is responsible and must ensure their employee received adequate training in the workplace related to proper practice to ensure they work in the healthy and safe environment. If training were not conducted by their employer, this would affect the workers' practice beyond pure negligence or improper practice.

This study tested the combination of scientific knowledge from multiple resources including local clinical practice guidelines and current available platform under the Occupational and Safety Unit in each state to determine whether this programme is significant to Malaysian culture and local HCWs context in terms of effectively and sustainably improving knowledge and ability to apply positive health literacy on TB. The results of the present study demonstrated its effectiveness for Malaysian and local context, as there was a positive and significant improvement in HCWs' knowledge and

attitude. There is no effect or improvement in practice on TB at short-term; however, there was a slight improvement in a longer timeframe. The results demonstrated that HCWs who participated in this programme are more likely to have good knowledge, positive attitude, and slight improvement of practice on TB effectively.

6.2 Strengths and Limitations

This is the first study conducted among HCWs in Malaysia to develop and assess the effectiveness of an intervention programme for TB disease and prevention. This STEP will be used as standard health education programme throughout the country for training purposes.

This intervention programme covered not only theoretical teaching, but also included practical teaching, which consists of proper handling of PPE including N95 masks and gloves and the proper method to discard or remove the PPE, a topic usually left out in other training modules.

Three limitations were noted in this study. First, the researcher is unable to assess the practical part of handling PPE by participants. Participants were taught the proper way to handle PPE but there was no assessment done to ensure participants were able to apply these skills in the workplace. Second, participants in this study were focused on nurses. However, this intervention programme was targeted for all HCWs, especially those on the front line. Therefore, similar interventions should be provided to other HCWs, especially health attendants who are considered high priority in view of findings from the cross-sectional study. Indeed, health attendants had the lowest percentage on high knowledge, positive attitude, and good practice compare with other healthcare professionals. Third, 23% or 130 participants dropped out during this study due to a variety of reasons but mainly because of daily work routines. Notably, the sociodemographic characteristics and the mean scores of KAP of those who dropped out were similar to participants who completed the study. However, in the future it would be advisable find ways to keep attrition to a minimum.

6.3 Recommendations

Two recommendations can be derived from this study. First, follow-up assessment was done at one month and three months after the STEP to evaluate the effectiveness of the intervention. However, it is also important to reassess at six months and one year after the STEP to assess the sustainability of the information from the programme over time and to help determine optimal frequency of assessments. Second, the STEP should include all job statuses and assess the effectiveness of this intervention programme for all HCWs.

Sustainability is the core of a successful health-related intervention program. Sustaining a program requires action in these six key components.

I. **Leadership**
II. **Partnership and Collaboration**
III. **Implementation**
IV. **Communication**
V. **Evaluation**
VI. **Financing**

. Leadership

Currently, Occupational health unit were given the responsibility to monitor and enforce programme related to safety and health of healthcare workers within Ministry of Health staff. Occupational health Unit should play their role in leadership by implementing this STEP programme as part of their annual programme. The ownership of this programme by occupational health unit can be done by supplement this programme in their Guideline of Tuberculosis Management and Prevention for healthcare workers in Malaysia. This will ensure all states in Malaysia will have access to the programme and implement it in their respective states.

• **Partnership and Collaboration**

STEP programme also can be improved by collaborating with other units such as Tuberculosis Unit and Communicable disease unit to widen the coverage of STEP programme to more healthcare workers as an annual training in respective units. Besides that, STEP can be introduced to private sector healthcare workers to ensure that this programme will benefit the private healthcare workers.

• **Implementation**

Implementation of this programme on regular and continuous basis plays an important part to monitor the long-term goal of this programme. Therefore, this programme must be included as compulsory programme in Occupational health unit their plan of action. This programme also should be done as compulsory programme for newly registered healthcare workers during their orientation week.

• **Communications**

Communications plays an important role to convey the content of STEP programme to targeted participants. Therefore, adequate training must be given to representative facilitators and trainer from all the states in Malaysia on STEP programme module. This is to ensure all trainers will deliver the programme in similar and standard approach.

• **Evaluation**

Evaluation also plays an important role to ensure the sustainability of STEP programme. Evaluation should be done based on process evaluation and outcome evaluation. Process evaluation will provide information on how to improve the current STEP programme and improve the content if necessary in future. Meanwhile, outcome evaluation is important to monitor the short, medium and long-term goals and objectives are achieved after STEP and impact of the STEP programme.

• **Financing**

Financing plays a major role in sustaining STEP programme. This is because STEP programme requires resources such as place for training, transportation for participants, reading materials and cost to conduct a full day course in each state every year. Therefore, allocation of budget for this programme as an annual compulsory course will greatly benefit to sustain STEP programme.

REFERENCES

Ahmed M, Fatmi Z, Ali S, Ahmed J, Ara N. Knowledge, Attitude and Practice of Private Practitioners regarding TB-DOTS in a rural district of Sindh, Pakistan. J Ayub Med Coll Abbottabad. 2009; 21(1):28-31.

Al-Maniri, Abdullah A.; Al-Rawas, Omar A.; Al-Ajmi, Fatmah; De Costa, Ayesha; Eriksson, Bo; Diwan, Vinod K.; (2008); Tuberculosis suspicion and knowledge among private and public general practitioners: Questionnaire-Based Study in Oman; BMC Public Health; Vol. 8;

Alonso-Echanove J, Granich RM, Laszlo A, et al. (2001) Occupational transmission of Mycobacterium tuberculosis to health care workers in a university hospital in Lima, Peru. Clin Infect Dis 33: 589–596.

Atulomah, N. O., & Oladepo, O. (2002). Knowledge, perception and practice with regards to occupational risks of HIV/AIDS among nursing and midwifery students in Ibadan, Nigeria. African Journal of Medicine and Medical Sciences, 31(3), 223-227.

Awofeso N, Schelokova I, Dalhatu A. Training of front-line health workers for tuberculosis control: lessons from Nigeria and Kyrgyzstan. Hum Resour Health. 2008;6:20.

Baussano I, Nunn P, Williams B, Pivetta E, Bugiani M, Scano F. Tuberculosis among healthcare workers. Emerg Infect Dis. 2011;17(3):488– 494.

Badran, I. G. (1995). Knowledge, attitude and practice the three pillars of excellence and wisdom: a place in the medical profession. Eastern Mediterranean Health Journal, 1(1),8-16.

Bhebhe LT, Van Rooyen C, Steinberg WJ. Attitudes, knowledge and practices of healthcare workers regarding occupational exposure of pulmonary tuberculosis. Free State, South Africa, Afr J Prm Healthcare Fam Med. 2014; 6(1):1-6.

Bennett, G., & Mansell, I. (2004). Universal precautions: a survey of community nurses' experience and practice. Journal of Clinical Nursing, 13(4), 413-421.

Becker, M.H. The Health Belief Model and Personal Health Behavior. Health Education Monographs. Vol. 2 No. 4.

Becker, M.H.,Radius, S.M., & Rosenstock, I.M. (1978). Compliance with a medical regimen for asthma: a test of the health belief model, Public Health Reports, 93, 268 77

Berger, David; Bratu, Eugenia; (2006); Tuberculosis Knowledge, Attitudes and Practices in Romania: A Patient-Centred Assessment; Romanian Association for Cognitive Science; Volume X, No. 1; pp. 93 – 104

Borotto S, Gamez D, Diaz D, Martinez Y, Ferrer AI, Velasquez Y, et al. Latent tuberculosis infection among healthcare workers at a general hospital in Santiago de Cuba. Int J Tuberc Lung Dis. 2011;15(11):1510–1514.

Buregyeya E, Kulane A, Colebunders R, et al. Tuberculosis knowledge, attitudes and health-seeking behaviour in rural Uganda. Int J Tuberc Lung Dis. 2011;15(7):938–42

Calabro, K., Weltge, A., Parnell, S., Kouzekanani, K., & Ramirez, E. (1998). Intervention for medical students: effective infection control. American Journal of Infection Control, 26(5), 431-436.

Champion, V.L. (1984). Instrument development for health belief model constructs, Advances in Nursing Science, 6, 73-85.

Cope, P., Cuthbertson, P., & Stoddart, B. (2000). Situated-learning in the practice placement. Journal of Advanced Nursing, 31(4), 850-856.

Costa JCT, Silva R, Ferreira J, Nienhaus A. Active tuberculosis among health care workers in Portugal. J Bras Pneumol. 2011;37(5):636–645.

David O. A. Knowledge, Attitude and Practices of healthcare workers about prevention and control of Multidrug-Resistant Tuberculosis at Botsabelo Hospital Maseru, Lesotho, 2011: Master's thesis, University of Limpopo, South Africa (Unpublished).

Demissie G, Aderaw A and Tilahun K, Assessment of knowledge and practice of health workers towards tuberculosis infection control and associated factors in public health facilities of Addis Ababa, Ethiopia: BMC public health. 2015; 73(15): 1-9.

Dimitrova B, Hutchings A, Atun R, et al. (2005) Increased risk of tuberculosis among health care workers in Samara Oblast, Russia: Analysis of notification data. Int J Tuberc Lung Dis 9: 43–48.

Dhiraj K, Ashok M, Subodh M, Mahendra C, Pankaj J, Neeraj G, et.al A comparative assessment of KAP regarding Tb and RNTCP among government and private practitioner in district Gwalior, India. Indian Journal of Tuberculosis, 2011; 58: 168-177.

Diekema, D. J., Schuldt, S. S., Albanese, M. A., & Doebbeling, B. N. (1995). Universal precautions training of preclinical students: impact on knowledge, attitudes, and compliance. Preventive Medicine, 24(6), 580-585.

Eckman, K., & Walker, R. (2008). Knowledge, Attitudes and Practice (KAP) Survey Summary Report for the Duluth Lakeside Stormwater Reduction Project (LSRP). Duluth: University of Minnesota.

Eagly, A. H., & Chaiken, S. (2007). The advantages of an inclusive definition of attitude. Social Cognition, (5), 582.

Eyob G, Gebeyhu M, Goshu S, Girma M, Lemma E, et al. (2002) Increase in tuberculosis incidence among the staff working at the Tuberculosis Demonstration and Training Centre in Addis Ababa, Ethiopia: A retrospective cohort study (1989–1998). Int J Tuberc Lung Dis 6: 85–88

Farley J E, Tudor C, Mphahlele M, Franz K, Perrin N A, Dorman S, Van der Walt M. A national infection control evaluation of drug-resistant tuberculosis hospitals in South Africa: Int J Tuberc Lung Dis, 2012; 16(1): 1-16.

Furtak M, Książek P, Warchoł-Sławińska E, et al. Development of healthcare market – forecasts for the future. Zdr Publ. 2011;121(1):76-80.

Garner, J. S. (1996). Guideline for isolation precautions in hospitals. American Journal of Infection Control, 24(1), 24-52.

Gueritault-Chalvin, V., Kalichman, S. C., Demi, A., & Peterson, J. L. (2000). Work-related stress and occupational burnout in AIDS caregivers: test of a coping model with nurses providing AIDS care. AIDS Care, 12(2), 149-161.

Haasnoot PJ, Boeting TE, Kuney MO, van Roosmalen J. Knowledge, attitudes, and practice of tuberculosis among maasai in simanjiro district, Tanzania. Am J Trop Med Hyg. 2010;83(4):902–5. doi: 10.4269/ajtmh.2010.10-0061.

Hashim DS, Al Kubaisy W, Al Dulayme A. Knowledge, attitudes and practices survey among healthcare workers and tuberculosis patients in Iraqi. East Medite Health J. 2003; 9(4):718-31.

Harries AD, Nyirenda TE, Banerjee A, Boeree MJ, Salaniponi FM (1999) Tuberculosis in health care workers in Malawi. Trans R Soc Trop Med Hyg 93: 32–35.

Havward CM, Herrman JL, Griffin GE. Drug-resistant tuberculosis: Mechanisms and Management. Br J Hosp Med. 1995; 54(10): 494-500.

Holtz TH, Lancester J, Laserson KF, Wells CD, Thorpe L, Weyer K. Risk factors associated with default from multidrug-resistant tuberculosis treatment. Int J Tuberc Lung Dis. 2006; 10(6): 649-55.

Hoa NP, Thorson AE. Diagnosis and treatment of pulmonary tuberculosis at basic health care facilities in rural Vietnam: a survey of knowledge and reported practices among health staff. Health Policy. 2005, 72: 1-8.

Hosoglu S, Tanrikulu AC, Dagli C, Akalin S (2005) Tuberculosis among healthcare workers in a short working period. Am J Infect Control 33: 23– 26.

Heimbeck J. Om tuberkuloseresistens. Norsk Mag Lægevidensk 1927; 88: 457–471
Heimbeck J. Infeksjonsintensitetens betydning for utvikling av tuberkuløs sykdom. Tidsskr Nor Lægeforen 1952; 72: 1–14.

Jackson, Marguerite; Harrity, Shawn; Hoffman, Helene; Catanzaro, Antonino;(2007); A survey of health professions students for knowledge, attitudes, and confidence about tuberculosis, 2005; BMC Public Health; Vol. 7.

Jaccard, J., Dittus, P., & Gordon, V. (1996). Maternal correlates of adolescent sexual and contraceptive behaviour. Family Planning Perspectives, 28(4), 159.

Jain M, Chakole SV, Pawaiya AS, Mehta SC. Knowledge, Attitude and Practice of DOTS Providers Under RNTCP in Ujjain, Madhya Pradesh. Natl J Community Med 2012; 3(4):670-4.

Jayaprakashm M. Knowledge, Attitude and Practice of Private General Practitioners in Davanger City Regarding TB and its control, 2010: Dissertation for Doctor of Medicine, Rajive Gandhi University of Health Sciences, Karnataka, Bangalore.

Jelip J, Mathew GG, Yusin T, Dony, JF, Singh N, Ashaari M, et al. Risk factors of tuberculosis among health care workers in Sabah, Malaysia. Tuberculosis. 2004;84:19–23.

Jeffe, D. B., Mutha, S., Kim, L. E., Evanoff, B. A., & Fraser, V. J. (1999). Evaluation of a preclinical, education and skills-training program to improve students' use of blood and body fluid precautions: one-year follow-up. Preventive Medicine, 29(5), 365-373.

Joshi R, Reingold AL, Menzies D, Pai M. Tuberculosis among health-care workers in low- and middle-income countries: A systematic review. PLoS Medicine. 2006;3(12)

Kanjee Z, Catterick K, Moll AP, Amico KR, Friedland GH, 4 Tuberculosis infection control in rural South Africa: survey of knowledge, attitude and practice in hospital staff. J Hosp Infect. 2011;79:333–8.

Kiefer E, Shao T, Carasquillo O, Nabeta P, Seas C. Knowledge and attitudes of tuberculosis management in San Juan de Lurigancho district of Lima Peru. J Infect Dev Ctries 2009; 3(10):783-788.

Książek P, Herda J, Pawka B, et al. Health education as an Essential standard in healthcare prevention for students in education environment in Lublin. Zdr Publ. 2008;118(4):403-5.

Kilinc O, Ucan ES, Cakan MD, et al. (2002) Risk of tuberculosis among healthcare workers: Can tuberculosis be considered as an occupational disease? Respir Med 96: 506–510.

Killen, R. (1992). Student-centred Teaching Strategies (2 ed.). Newcastle: University of Newcastle Department of Pedagogical Studies.

LoBue, P.A.; Moser, K.; Catanzaro, A.; (2001); Management of tuberculosis in San Diego county: a survey of physicians'' knowledge, attitudes and practices; International Journal of Tuberculosis and Lung Disease; Vol. 5, No. 10.

Lertkanokkun S, Okanurak K, Kaewkungwal J, Meksawasdichai N. Healthcare providers' knowledge, attitudes & practices regarding tuberculosis care. JIMM 2013; 2:1-10.

Loveday M, Thomson L, Chopra M, Ndlela Z. A health systems assessment of the KwaZulu-Natal tuberculosis programme in the context of increasing drug resistance. Int J tuberc Lung Dis. 2008; 12(9): 986.

Minnery M, Contreras C, Pérez R, Solórzano N, Tintaya K, Jimenez J, et al. A Cross-Sectional Study of Knowledge and Attitudes Towards Tuberculosis amongst Front-

Line Tuberculosis Personnel in High Burden Areas of Lima, Peru. PLoS ONE 2013: 8(9).

McCann, T. V., & Sharkey, R. J. (1998). Educational intervention with international nurses and changes in knowledge, attitudes, and willingness to provide care to patients with HIV/AIDS. Journal of Advanced Nursing, 27(2), 267-273.

Ministry of Health Malaysia. Guidelines on prevention and management of tuberculosis for health care workers in Ministry of Health Malaysia. Malaysia: MOH Malaysia; 2012.

Minnery M, Contreras C, Perez R, et al. A cross-sectional study of knowledge and attitudes towards tuberculosis amongst front-line tuberculosis personnel in high burden areas of Lima, Peru. PLoS ONE. 2013;8(9)

Moore, D., Gamage, B., Bryce, E., Copes, R., & Yassi, A. (2005). Protecting health care workers from SARS and other respiratory pathogens: organizational and individual factors that affect adherence to infection control guidelines.

Moloi TS. The provision of tuberculosis patient care: A sociological perspective on primary health care nurses in the Qwa- Qwa district of Free State. University of Pretoria edn. 2003.

Naidoo S, Taylor M, Jinabhal CC. Critical factors driving the tuberculosis epidemic in Kwazulu-Natal, South Africa. The Southern Africa J Epid and Inf. 2007; 22 (23): 45-49.

Naidoo S, Taylor M, Esterhuizen TM, et al. Changes in healthcare workers' knowledge about tuberculosis following a tuberculosis training programme. Educ Health (Abingdon) 2011;24(2):514

Nassaji M, Ghorbani R. Risk factors for latent tuberculosis infection among healthcare workers in a university-affiliated hospital. South Afr J Epidemiol Infect. 2012;27(1):30–33.

Nshuti, L.; Neuhauser, D.; Johnson, J. L.; Adatu, F.; Whalen, C. C.; (2001); Public and private providers'' quality of care for tuberculosis patients in Kampala, Uganda; International Journal of Tuberculosis and Lung Disease; Vol. 5, No. 11.

Piecewicz-Szczęsna H, Karwat D. Health and demographic problems Polish society and the types of tasks in the field of health education. Zdr Publ. 2010; 120 (3): 295-9

Perry, C. (2001).

Perry, J., & Paterson, B. L. (2005). Nursing rounds as a pedagogical strategy: anchoring theory to practice in gerontological nursing. Nurse Education in Practice, 5(2), 63-69.

Polit, D. F., & Beck, C. T. (2004). Nursing Research: Principles and Methods (7 ed.). Philadelphia: Lippincott Williams & Wilkins.

Rafiza S, Rampal KG, Tahir A. Prevalence and risk factors for latent tuberculosis infection among healthcare workers in Malaysia. BMC Infectious Disease. 2011;11(9):1–7.

Ramazan K, Onder E, Ziya D, Sebnem E, Nurcan B, Basak D. Risk of Tuberculosis infection among healthcare workers in a tertiary-care hospital in Ankara, Turkey. Infection Control. 2004;25:1067–1071.

Ronveaux O, Jans B, Wanlin M, Uydebrouk M. Prevention of transmission of tuberculosis in the hospital; a survey of practices in Belgium. J Hosp Infec. 1997; 37(3): 207-15.

Roy A, Abubakar I, Chapman A, et al. A controlled trial of the knowledge impact of tuberculosis information leaflets among staff supporting substance misusers: a pilot study. PLoS ONE. 2011;6(6)

Rosenstock, I. (1974). Historical Origins of the Health Belief Model. *Health Education Monographs*. Vol. 2 No. 4.

Sepkowitz KA, Friedman, CR, Hafner A, Kwok D, Manoach MF, Martinez D, et al. Tuberculosis among urban health care workers: A study using restriction fragment length polymorphism typing. Clinical Infection Disease. 1995;21(5):1098– 1102.

Sokas, R. K., Simmens, S., & Scott, J. (1993). A training program in universal precautions for second-year medical students. Academic Medicine, 68(5), 374-376.

Tudor C, Van Der Walt M, Margot B, Dorman SE, Pan WK, Yenokyan G, Farley, J.E. Tuberculosis among health care workers in KwaZulu-Natal, South Africa: a retrospective cohort analysis. BMC Public Health. 2014;14:891.

Tan LH, Kamarulzaman A. Preventing tuberculosis in healthcare workers of the radiology department: a Malaysian perspective. Biomedical Imaging and Intervention Journal. 2006;2(1)

Temesgen C, Demissie M. Knowledge and practice of tuberculosis infection control among health professionals in Northwest Ethiopia: BMC Health Services Research.2011;14(593):1-7.

Tenna A, Stenehjem EA, Margoles L, Kacha E, Blumberg H, Kempker RR. Infection Control Knowledge, Attitudes, and Practices among Healthcare Workers in Addis Ababa, Ethiopia: Infect Control Hosp Epidemiol. 2013; 34(12): 1289–1296.

Tudor C, Van Der Walt M, Margot B, Dorman SE, Pan WK, Yenokyan G, Farley, J.E. Tuberculosis among health care workers in KwaZulu-Natal, South Africa: a retrospective cohort analysis. BMC Public Health. 2014;14:891.

Uwakwe, C. B. U. (2000). Systematized HIV/AIDS education for student nurses at the University of Ibadan, Nigeria: impact on knowledge, attitudes and compliance with universal precautions. Journal of Advanced Nursing, 32(2), 416-424.

Ukwaja K, Alobu I, and Onu E. Frontline healthcare workers' knowledge of tuberculosis in rural south-east Nigeria. African Journal of Respiratory Medicine. 2013; 9(1):7-10.

Vanden Driessche K, Sabue M, Dufour W, Behets F, Van Rie A. Training health care workers to promote HIV services for patients with tuberculosis in the democratic republic of Congo. Hum Resour Health. 2009;7:23

Vandan N, Ali M, Prasad R, Kuroiwa C. Assessment of doctors' knowledge regarding tuberculosis management in India: A public-private sector comparison. Public Health. 2009; 123(7): 484-9

Wang, W.-L., Lin, W.-C., Cho, Y.-W., & Chang, M.-Y. (2003). Knowledge, attitudes and behaviors of students in Chungtai Institute of Health Science and Technology about SARS. Chungtai Bulletin of Student Studies, 51-63.

White Z N. Survey on the knowledge, attitudes and practices on tuberculosis (TB) among healthcare workers [MPH thesis]. Kingston & St. Andrew, Jamaica: The University of Liverpool; 2011.

Woynarowska B. Health education. Academic manual.Warsaw: Wydawnictwo Naukowe PWN; 2007.

Warren, D. K., Zack, J. E., Cox, M. J., Cohen, M. M., & Fraser, V. J. (2003). An educational intervention to prevent catheter-associated bloodstream infections in a nonteaching, community medical centre. Critical Care Medicine, 31(7), 1959-1963.

Won, S.-P., Chou, H.-C., Hsieh, W.-S., Chen, C.-Y., Huang, S.-M., Tsou, K.-I., et al. (2004). Handwashing program for the prevention of nosocomial infections in a neonatal intensive care unit. Infection Control and Hospital Epidemiology, 25(9), 742-746.

WHO (World Health Organization); (2006a); The Stop TB Strategy: Building on and enhancing DOTS to meet the TB-related millennium development goals; Geneva, Switzerland.

WHO (World Health Organization); (2006b); Advocacy, Communication and Social Mobilization to Fight TB: A 10-year Framework for Action; France.

WHO (World Health Organization); (2008); Advocacy, communication and social mobilization for TB control: A guide to developing knowledge, attitude and practice surveys; Geneva, Switzerland.

World Health Organization (WHO); (2010c); The Global Plan To Stop TB 2011 –2015: Transforming the Fight Towards Elimination of Tuberculosis; Geneva, Switzerland

World Health Organization. Guideline for the prevention of tuberculosis in health care facilities in resource-limited settings. Switzerland: WHO Press; 1999.

Wurtz, R., Dolan, M., O'Neal, B., & Azarcon, E. (1994). Infection control instruction and screening for students. American Journal of Infection Control, 22(5), 322-324.

Woith W M, Volchenkov G, Larson J L. Russian healthcare workers' knowledge of tuberculosis and infection control. Int J Tuberc Lung Dis 2010; 14(11): 1489-1492.

Yimer S, Carol H, Gunnar A. Assessment of knowledge and practice of private practitioners regarding tuberculosis control in Ethiopia. J Infect Dev Ctries. 2012; 6(1):13-19.

Yen, M.-Y., Lin, Y. E., Su, I.-J., Huang, F.-Y., Huang, F.-Y., Ho, M.-S., et al. (2006). Using an integrated infection control strategy during outbreak control to minimize nosocomial infection of severe acute respiratory syndrome among healthcare workers. Journal of Hospital Infection, 62(2), 195-199.

Yu, D. S. F., Lee, D. T. F., & Woo, J. (2003). Translation of the chronic heart failure questionnaire. Applied Nursing Research, 16(4), 278-283.

Yu CT, Zantua RR, Sto LJ. Pulmonary Tuberculosis: Knowledge, Attitudes and Practices of selected physicians in Tertiary-Care Hospital. Phil J. Microbiol. Inf Dis. 2002; 31 (1): 1-8.

Zack, J. E., Garrison, T., Trovillion, E., Clinkscale, D., Coopersmith, C. M., Fraser, V. J., et al. (2002). Effect of an educational program aimed at reducing the occurrence of ventilator-associated pneumonia. Critical Care Medicine, 30(11), 2407-2412.