Addis Ababa University
College of Health Sciences
Department of Medical Laboratory Science

ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICE OF LABORATORY PERSONNEL TOWARDS THE BIOSAFETY MEASURE FOR TUBERCULOSIS TESTING LABORATORY IN SELECTED HEALTH INSTITUTIONS IN ADDIS ABABA, ETHIOPIA.

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ETHIOPIA

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Acronym

- **TB** Tuberculosis
- **DST** Drug susceptibility test
- **MDR-TB** Multiple drug resistance- tuberculosis
- **XDR-TB-** Extensively drug resistant- tuberculosis
- **HI-** Health Institutions
- **TB IC-** Tuberculosis infection control
- **IPC-** Infection privation and Control
- **HH-** Hand hygiene
- **HCW-** Health care worker
- **BSC-** Biological safety cabinet
- **UV-** Ultra violet
- **PPD/E-** Personal protective equipment/device
- **WHO-** World health organization
- **HIV-** Human Immuno Deficiency Virus
- **HEPA-** High-efficiency particulate air
- **KAP-** Knowledge, attitude and practice
- **SOP-** Standard operating procedures
- **Lab-** Laboratory
- **IPC-** Infection prevention control
- **AFB-** Acid fast bacillus
- **EFMHACA-** Ethiopia food, medicine and healthcare administration and control agency
- **AAFMHACA-** Addis Ababa food, medicine and healthcare administration and control agency

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OPERATIONAL DEFINITION

Tuberculosis: when active TB affects the lungs and causes a persistent cough (sometimes with bloody sputum), chest pain, exhaustion, night sweets, fever, loss of appetite, weight loss and shortness of breath.

Knowledge: in this study, it is measured based on respondent's ability to respond to questions about biosafety measure for TB testing laboratory.

Attitude: The predisposition to responding favorable or unfavorable manner to towards a Tb specific biosafety measure.

Practice: The actual/ intended actions related to biosafety measure are taking in different situation and conditions.

Low Tb risk laboratory: Direct sputum-smear microscopy.

Moderate Tb risk laboratory: Procedures that liquefy specimens such as those used during specimen digestion and processing for culture inoculation, direct DST or direct line- probe assays.

High Tb risk laboratory: manipulation of culture for indirect DST or line-probe assays

ABSTRACT

TITLE: Assessment of knowledge, attitude and practice of laboratory personnel towards the biosafety measure for tuberculosis testing laboratory in selected health institution in Addis Ababa, Ethiopia

By: - Henok Birhanu(Addis Ababa,2014)

Background: Transmission of tuberculosis (TB) in health care settings to both patients and health care workers (HCWs) has been reported from virtually every country of the world and TB is the second leading cause of death from an infectious disease worldwide, after the human immunodeficiency virus (HIV). It is caused by *Mycobacterium tuberculosis* and is transmitted mainly through aerosolization of infected sputum which puts laboratory workers at risk in spite of the laboratory workers' risk of infection being at 3 to 9 times higher than the general public. Laboratory safety should therefore be prioritized and optimized to provide sufficient safety to laboratory workers.

Objective: - To assess the knowledge, attitude and practice of laboratory personnel on biosafety measure for Tb testing laboratories.

Method: - A cross-sectional descriptive study was conducted from August 2013-May 2014 by using convenient sampling technique. A total of 126 laboratories professionals who have been working in Addis Ababa both governmental and private health institutions were enrolled. The data were collected by using well-structured questionnaires.

Result: -In this study 126 laboratory professional were involved. Of them37.3% of were laboratory technician and 66.7% were male. Majority of them had <=5 years of work experience and 69.8% recruited from higher clinic. The overall knowledge, attitude and practice of the participant were 67.5%, 81.7% and 42.15 respectively. It was observed a major practice gap towards biosafety measure like only 17(13.5%) had directional air flow, 18(14.3%) had isolated lab,23(18.3%) had color coded plastic container for waste segregation,29(23%) had fire extinguisher,53(42.1) had restrict their lab access,15(11.9%) posted biohazard sign on the lab door,20(15.9%) had updated safety manual,34(27%) had trained on biosafety and only 32(5.4%) appointed biosafety officer. Level of knowledge had significance association with educational level (OR=0.211, 95CI=0.74-0.605, P-value=0.004). Degree holder had satisfactory knowledge as compared to diploma holder. But there were major gaps in practice. Further, the laboratory personnel work in health center had good practice as compared to private higher clinic (OR=6.951, 95%CI=2.773-17.424, P-value=0.000). Working in higher clinic had high risk of getting Tb infection

Conclusion: - The study concluded that knowledge and attitude towards biosafety measure is good. However, The relatively good knowledge and attitude were not equally translated into practice. Lack of trained lab personnel and assigned safety officer had major contribution to had poor practice.

1. Introduction

1.1 Background

Tuberculosis remains a major global health problem. It causes ill-health among millions of people each year and ranks as the second leading cause of death from an infectious disease worldwide, after the human immunodeficiency virus. TB is an infectious disease caused by the bacillus Mycobacterium tuberculosis. It typically affects the lungs but can affect other sites as well. The disease is spread in the air when people who are sick with pulmonary TB expel bacteria, for example by coughing. In general, a relatively small proportion of people infected with Mycobacterium tuberculosis will develop TB disease; however, the probability of developing TB is much higher among people infected with the human immunodeficiency virus (1).

Laboratory-acquired infections often result from the unrecognized production of infectious aerosols containing tubercle bacilli. For laboratories conducting TB testing, the most important hazard (or risk) is the generation of infectious aerosols since infection with *Mycobacterium tuberculosis* occurs primarily through the inhalation of infectious aerosols, although it can also occur through direct inoculation or ingestion. Infectious aerosols may be generated during the manipulation of liquids containing tubercle bacilli. After settling on surfaces, droplet nuclei are not reaerosolized and are considered noninfectious. That is, *M. tuberculosis* bacteria are usually transmitted only through air, not by surface contact (2).

Laboratory biosafety is the process of applying a combination of administrative controls, containment principles, practices and procedures, safety equipment, emergency preparedness, and facilities to enable laboratory staff to work safely with potentially infectious microorganisms. biosafety also aims at preventing unintentional exposure to pathogens or their accidental release. Biosafety manual describes the minimum biosafety measures that should be implemented at the different levels of tuberculosis testing laboratories to reduce the risk of a laboratory acquired infection (3)

The most common method for diagnosing TB worldwide is sputum smear microscopy, in which bacteria are observed in sputum samples examined under a microscope. Following recent

developments in TB diagnostics, the use of rapid molecular tests for the diagnosis of TB and drug-resistant TB is increasing. In countries with more developed laboratory capacity, cases of TB are also diagnosed via culture methods which is the current reference standard (4)

TB laboratory facilities can be classified into three main levels of procedural risk, based on the activities being performed and their associated risks; low TB risk, moderate TB risk and high TB risk. The probability of aerosols being generated is a key factor to consider in determining the level of risk and the necessary mitigation or control measures. Direct sputum-smear microscopy, when performed using good microbiological techniques, entails a low risk of generating infectious aerosols, and this procedure may therefore be performed on an open bench, provided that adequate ventilation can be assured. Guidance and recommendations for safe practices to be followed when performing direct smear microscopy have been described in WHO's guidelines on laboratory services for TB control. Procedures that liquefy specimens such as those used during specimen digestion and processing for culture inoculation, direct DST or direct line-probe assays – have an increased risk of generating aerosols when compared with other techniques even when good microbiological technique is used; thus, these procedures should be performed in a BSC. Manipulation of cultures for indirect DST or line-probe assays involves procedures where a high concentration of bacilli are present and a high risk of aerosol generation exists such activities must be performed in a BSC within a TB containment laboratory(5).

Two important considerations in evaluating the risk of aerosolization are the bacillary load of the materials being manipulated and the likelihood of generating infectious aerosols from the material. For sputum specimens (the most common specimen investigated for TB), the bacillary load ranges from 0 (this is the case for up to 90% of diagnostic samples) to 10^3-10^4/ml in a sputum specimen with a scanty smear grading, to 10^6/ml in a sample with a 3+ grading. In a culture grown from sputum specimens, the bacillary load may exceed 10^8/ml. Due to the viscosity of sputum specimens, the likelihood of generating an infectious aerosol while manipulating such specimens is much lower than the likelihood of generating an infectious aerosol from a liquid culture. Consequently, the risk associated with manipulating a direct sputum sample is significantly less than that associated with handling cultured material (6).

1.2 Statement of the Problem

In 2011, there were an estimated 12 million prevalent cases, 8.7 million incident cases and a total of 1.4 million people died of TB in 2011. Most of the estimated number of cases in 2011 occurred in Asia (59%) and Africa (26%). Smaller proportions of cases occurred in the Eastern Mediterranean Region (7.7%), the European Region (4.3%) and the Region of the Americas (3%) (7).

Molecular studies suggest that 32 to 42% of TB cases among HCW are related to occupational exposure. Tuberculosis is an occupational risk hazard that explains 5 to 5.361 additional cases of TB per 100.000 individuals among healthcare workers (HCW) in relation to general population in developing countries. (8).

The incidence of tuberculosis in laboratory personnel working with *M. tuberculosis* has been reported to be three times higher than that of those not working with the *M. tuberculosis*. Infections are a proven hazard to laboratory personnel as well as others who may be exposed to infectious aerosols in the laboratory, autopsy rooms, and other healthcare facilities (9)

The prevalence of tuberculosis infection in healthcare workers (HCWs) is completely unknown in Mexico. Prevalence study of tuberculin reactivity among a random sample of asymptomatic HCWs showed that (70%) of HCWs among 175 were extremely reactive, probably related to the high incidence of active TB in the general population and to the absence of preventive programs (10).

The greater number infection in small laboratory reflect that greater no of generalist who have less experience working with infectious agent and not realized universal precautions and causative agent transmitted by aerosol led to develop and use biological cabinet. All biological materials from patient should be considered as potationally as infections. Inflection prevention and control (IPC) is high on the agenda of World Health Organization and national development of health and quality assurance (11).

Laboratory infection shows annual indecency of 3 infections per 1000 employers. The incidence of infection was 3 times higher in small laboratories than larger laboratories. About 3.5 infections per 1000 employer in Minnesota have been reported. Bacteria are the most prominent laboratory acquired infection followed by viruses and rickettsia. The root of transition of these agents is by aerosol (12).

Tuberculosis infection control interventions are not routinely implemented in many Sub-Saharan African countries including Nigeria. Nine (3.3%) had their sputum positive for acid fast bacilli (AFB) while six (2.2%) were positive for culture .The study shows that occupationally-acquired PTB is real in Ibadan.(13).

Ethiopia has the seventh highest TB burden globally and ranks third in Africa. The prevalence of smear positive TB among people aged 15 and above was 108/100,000 (95% C.I. 73-143). The prevalence of bacteriological confirmed TB within the same age group was 277/100,000 (95% C.I. 208-347).The observed prevalence of smear positive TB from the total population, including children, was estimated to be 64/100,000 population (14).

There for, considering the magnitude of the problem and the higher risk in medical laboratory personnel we aim to conduct this research.

1.3 Significance of the Study

Identification of the gap by assessing their knowledge, attitude and practice of laboratory personnel towards biosafety measure and forward the information to each sub city to strength their regulation and support them by providing Tb specific biosafety training, provide updated information for standard maker and the information disseminated to the clinic to strengthen Tb infection control program which may prevent laboratory personnel from Tb infection.

2. Literature Review

Study was conducted in Brazil 2012 by Mussi TV, et al. Nursing students and professionals showed a vulnerability to TB related to knowledge about transmission, preventive and biosafety measures, and diagnosis of the disease. With respect to transmission, vulnerability was higher among nursing professionals. The results indicate the need for investment by healthcare institutions surrounding this topic in view of the important role of nursing in the establishment of strategies for prevention and control of the disease (15).

A cross section study was conducted by Robert J, et al, in health facilities of 4 sub-Saharan (Benin, Cameroon, Cote d'Ivoire, and Togo) countries in 2010. None had a TB infection control plan, and only 5.2% provided education for staff about nosocomial TB. Overall, 48.3% of the facilities performed triage of suspected TB cases on hospital arrival or admission, 89.6% provided education for TB cases on cough etiquette, 20.0% segregated smear-positive TB cases, and 15.7% segregated previously treated cases. A total of 15.5% of the facilities registered TB among staff, for a global prevalence rate of 348 cases per 100,000 staff member (16).

A study by Admasu T M et al, was completed between January-March 2012 at Addis Ababa University teaching hospitals in Ethiopia. TB IC knowledge is excellent among HCWs (> 90% correct). Most HCWs agreed they were at high risk of acquiring TB from patients (71%) that TB IC can prevent transmission within their hospital (92%) and TB IC is important to protect patients (95%). Only 27% of HCWs regularly wore a mask or respirator when caring for TB patients. Limited access to masks and no ability to isolate patients with or suspected of TB were the major limitations of TB IC. Half of HCWs felt UV lights may be harmful, and 11% reported a personal history of TB disease (17).

A study was conducted by Kanjee Z, in a resource-limited rural South African hospital in 2011. While knowledge and attitudes were generally supportive of TB IC implementation, 49.1% of staff felt that the hospital did not care about them and/or was not working to prevent staff TB infections, and 42.9% were less willing to continue as a healthcare worker because of staff TB/MDR-TB/XDR-TB deaths.41.5% of respondents were unaware of their personal human immunodeficiency virus (HIV) status (18).

A study conducted in Khartoum state in 2012 by Elduma AH. Found that 32 (16.8%) of laboratories appointed biosafety officers. Only, ten (5.2%) participated in training about response to fire emergency, and 28 (14.7%) reported the laboratory accident occurred during work. 45 (23.7%) laboratories had a written standard operation procedures (SOPs), and 35 (18.4%) had written procedures for the clean-up of spills. Moreover, biosafety cabinet was found in 11 (5.8%) laboratories, autoclave in 28 (14.7%) and incinerator in only two (1.1%) laboratories. Sharp disposable containers were found in 84 (44.2%). Fire alarm system was found in 2 (1.1%) laboratories, fire extinguisher in 39 (20.5%) laboratories, and fire emergency exit found in 14 (7.4%) laboratories (19).

Cross-sectional study conducted by Jitendra Z, at private hospital of Ahmedabad city in the year 2012.showed that all participants wear gloves during laboratory work but 81.2% wear a single pair. 17.5 % of the participants claimed to know what to do if exposed to infection. 45.6% of the participants eat in the laboratory, 47.0% of them store foods and water in the refrigerators, 31.5% of them put on cosmetics in the laboratory, 12.6% smoke in the laboratory,82.0% of the participants do not feel that the use of masks is necessary in laboratory (20)

Another study was conducted by Jyotsna V, et al. in a Teaching Hospital at Krishna Institute of Medical Sciences University 2013.In the study 19 technicians from Biochemistry, Pathology and Microbiology were involved in the study. Accordingly in knowledge in pathology 50% of study subjects were having average and 50% were having good scores while in biochemistry 25% had average and 75% had good scores and in microbiology 100% of study subjects had good grade. For attitude, in pathology dept 83.3% had average and 16.7% had good grades. In biochemistry 12.5% had poor grades, 75% had average grades and 12.5% had good grades. In microbiology 100% had good grades. For practice in pathology dept 16.7% had poor grades, 66.7% had average grades and 16.7% had good grades. In biochemistry 81.5% had average grade and 12.5% had good grades. In microbiology 100% of study subjects had good scores (21).

A study conducted in Pakistan in 2012 by Sadia N, et al. showed that 28.4% of the laboratory technicians from Punjab, 35.7% from Sindh, 32% from Balochistan and 38.4% from Khyber Pakhtoon Khawa (KPK) did not use any personal protective equipment. Almost 46% of the respondents said they reused syringes either occasionally or regularly.

Furthermore, 30.7% of the respondents said they discard used syringes directly into municipal dustbins. The majority (66.7%) claimed there are no separate bins for sharps, so they throw these in municipal dustbins. Standard operating procedures were not available in 67.2% labs, and accident records were not maintained in 83.4%. No formal biosafety training had been provided to 84.2% of the respondents (22).

A cross sectional study was conducted in western India in 2011 by Hansa M et al. The majority know the very important issues related with laboratory safety like Post Exposure Prophylaxis (96.55%) & discarding of blood samples (93.10%) etc. In regard to attitude towards the scientific process, all are very much aware about importance of protective devices (i.e. Wearing Gloves) and Biomedical waste management. In regard to the practice in laboratory, the entire study subject group (100%) replied “YES” in each question that shows the good quality work of the laboratory (23).

Another Study conducted in Nigeria 2013 by Oladeinde et al, showed that presence of an isolated unit for microbiological work, leak-proof working benches, self-closing doors, emergency exits, fire extinguisher(s), autoclaves, and hand washing sinks in 21.3%, 71.3%, 15.0%, 1.3%, 11.3%, 82.5%, and 67.5%, respectively, of all laboratories surveyed. It was observed that public diagnostic laboratories were significantly more likely to have an isolated unit for microbiological work, hand washing sink, and an autoclave than private ones. Routine use of hand gloves, biosafety cabinet, and a first aid box was observed in 35.0%, 20.0%, and 2.5%, respectively, of all laboratories examined. Written standard operating procedures, biosafety manuals, and biohazard signs on door entrances were observed in 6.3%, 1.3%, and 3.8%, respectively, of all audited laboratories (24).

3. Objectives

3.1 General objective

- The overall aim of the study was to assess the knowledge, attitude and practice of laboratory personnel on biosafety measure for Tb AFB testing laboratories.

3.2 Specific objective

- To assess knowledge of laboratory personnel on biosafety for Tb AFB diagnosis laboratories.
- To assess attitude of laboratory personnel on biosafety for Tb AFB diagnosis laboratories.
- To assess practice of laboratory personnel on biosafety for Tb AFB diagnosis laboratories.

4. Materials and methods

4.1 study Area

The study was conducted in Addis Ababa city administration in five sub city like Kirkos, Gullele, Arada, Kolfe Keranyo and Ldeta. Health Institutions which include 38 Health centers and 88 higher clinics. These facilities were selected based on the availability of Tb AFB diagnosis service, level of risk associated on the procedure they carry out and supervision and inspection feedback from Addis Ababa food, medicine and health care authority branch office.

4.2 Study design and period

An institutional based cross-sectional study was conducted using standardized self-administered questionnaires which enquire about knowledge and attitude and observational checklist to assess practice of laboratory personnel toward the biosafety measure for Tb AFB testing laboratory from August to May, 2014.

4.3 Source population

The source population includes laboratory personnel who work in Addis Ababa health institution.

4.4 Study population

The study population was laboratory personnel who have been working in five sub city Kirkos, Gullele, Arada, Kolfe Keranyo and Ldeta, both public and private selected health institution. It includes health centers and higher clinic which are working on Tb AFB testing.

4.5 Eligibility

4.5.1 Inclusion Criteria

- ❖ All laboratories professional working in microbiology laboratory specifically on Tb AFB testing.

4.5.2 Exclusion Criteria

- ❖ Laboratory professional not working in microbiology laboratory specifically on Tb AFB testing.
- ❖ Non laboratory professional

4.6 Sampling technique and Sample Sizes

A convenient non probability sampling technique was used to select study subjects .The sample size was 126 just by taking all higher clinic and health center who were working on diagnosing Tb AFB.

4.7 Sampling Method and procedure for KAP

A convenient non probability sampling technique was used to select study subjects. From the 10 sub cities 5 sub cities were selected. Then 38 health center and 88 higher clinics were selected from each sub city based on the availability of the Tb AFB testing service. Expected number of study participant in the data collection period was 126.

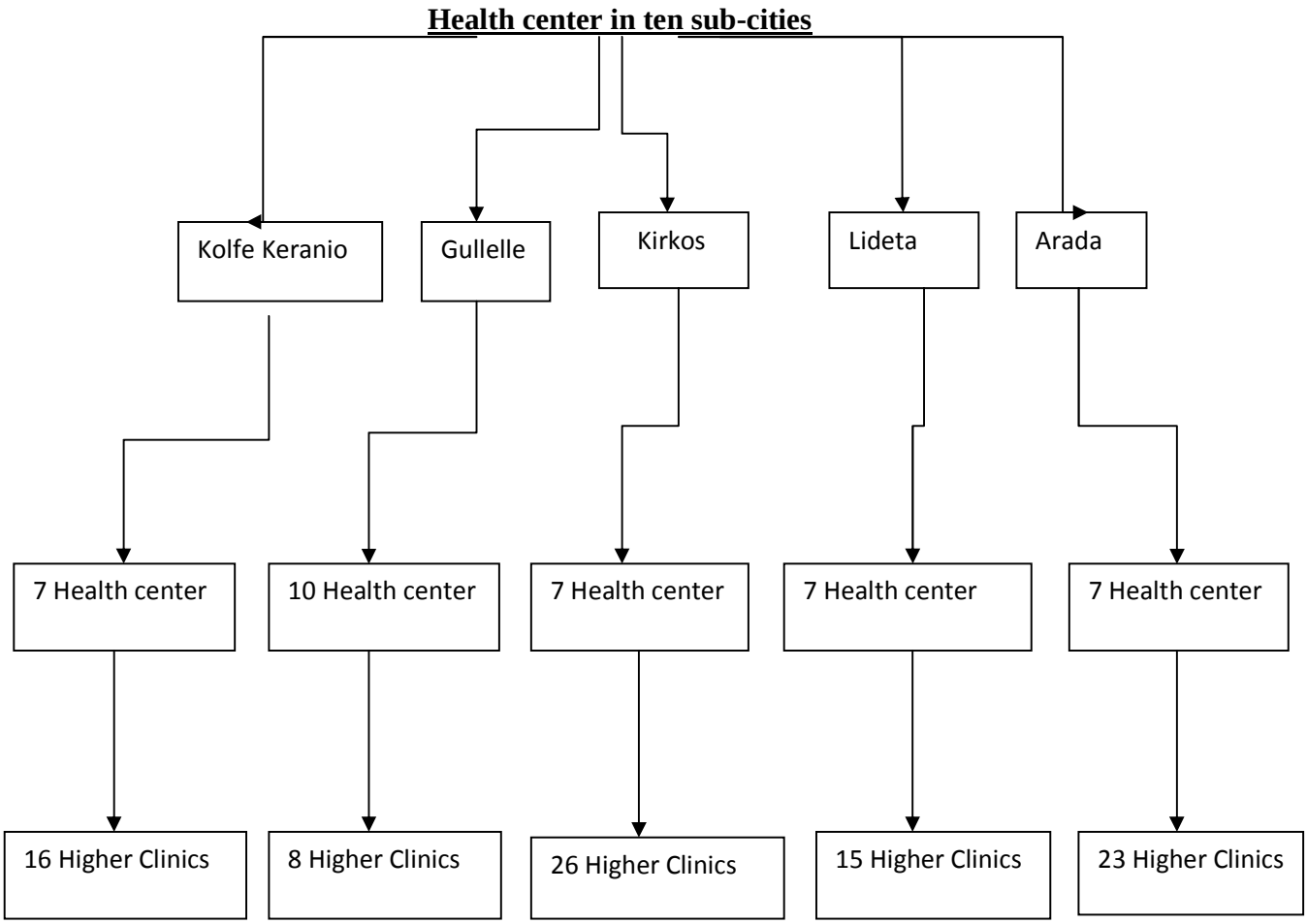

Fig-1 Schematic presentation of sampling procedure, May 2014.

4.8 study variables

4.8.1 Dependent variables.

- Knowledge
- Attitude
- Practice

4.8.2 Independent variables

- Age
- Sex
- Level of education
- Year of work experience
- Type of health institution

4.9 Data collection

A total of 126 standardized questionnaires were distributed which address socio-demographic characteristics, knowledge, attitude and practice about biosafety measure for Tb AFB testing laboratory. The participants were medical laboratory professional who work in the selected health institutions in both public and private. There were 10 data collectors who were mainly laboratory technologist who work in the five Addis Ababa food, medicine and healthcare authority control branch office and kirkos sub city higher clinic and health center. They were an experienced laboratory technician and technologist who had previous experience in data collection and had training on biosafety. Data was collected in working days at morning from April 7 to May 15, 2014. Only one of laboratory professional at Tb AFB testing room of each health institution was asked for filling the knowledge and attitude and the practice questioner. So there was no interference with the daily service. The lab professional that was willing to participate had spent 15-20 minutes of their time for the response.

4.9.1 Data Quality assurances

Data quality was maintained by pre-testing the 5% of the sample size in non-selected health institutions via pilot study for assessing content validity, appropriateness, and question comprehensibility. Then, the knowledge assessing questionnaire was revised. Standard training was given for the data collectors and supervisors in advance. Daily supervision and checking of data completion will be also done by supervisors.

4.10 Data processing and analysis

Data was entered in to Epi Info version 3.5.1 and cleaned. Then transferred to SPSS version 16.0 for analysis. The overall knowledge and attitude question concerning biosafety measure was assessed based on the private and public lab professional response but the practice question concerning biosafety measure was assessed by data collector. Correct answers were given a value of one and incorrect answers were given a value of 2. Knowledge was categorized as satisfactory knowledge or low level of knowledge; attitude was categorized as favorable attitude and non-favorable attitude and practice was categorized good practices and poor practice based on the cumulative result and the related mean value of responses. As outcome variables Scores above the mean value are categorized as satisfactory Knowledge and given a value of 1 while scores below the mean value are considered to represent low level of Knowledge and given a value of 2. Similar procedures are using in defining attitude and practices. Percentage and frequency were used to show distribution of descriptive data using tables. Bi-variant and multi-variant analysis were employed using logistic regression model for further analysis and interpreted based on the odds ratio and level of statistical significant at p-value <0.05.

4.11 Dissemination of Results

The finding of this thesis will be submitted to Department of Medical Laboratory Science, Addis Ababa University. Oral presentation of the thesis was made. Copy of the thesis was also submitted for EFMHACA, AAFMHACA and selected health institutions in Addis Ababa, Ethiopia. Furthermore, it will be published in peer reviewed journal.

5. Ethical issue

Ethical clearance was obtained from the Department Research and Ethical Review Committee of Addis Ababa University School of Allied Health Sciences, Department of Medical Laboratory sciences and Addis Ababa regional health bureau prior to the actual data collection procedure.

The research proposal was ethically cleared by Letter of permission obtained from the five sub city Kirkos, Gullele, Arada, Kolfe Keranyo and Ldeta. Letter of support was obtained from Addis Ababa University, College of Health Science, and Department of Medical Laboratory Science. Written and informed verbal consent was obtained each study subject was taken after clear explanation about the purpose, and aims of the paper. The study participants were assured for the confidentiality of their responses and no any special payment due to participating.

6. Result

6.1 Socio-demographic information

One hundred twenty six questionnaires were distributed, and all 126 were completed and returned; the response rate was 100%. Of them 42(33.3%) % of respondents were female and 84(66.7%) of them were male. Majority 61.9% of the respondent age was between 20-29 years. Most participants had bachelor degree 79(62.7%) and 47(37.3%) had diploma. Almost 84(66.7%) had worked for <=5 years and 88(69.8%) of the participant recruited from private higher clinic and 38(30.2%) from health center. A detailed characteristic of the study participants is shown in (Table 6.1).

Table 1: Distributions of socio-demographic characteristics of laboratory professional, at health center and higher clinic in Addis Ababa, Ethiopia 2014.

Socio-Demographic characters	Number (%) (n=238)
Sex of study participants	
Male	84(66.7)
Female	42(33.3)
Age of respondents	
20-29	78(61.9)
30-39	31(24.6)
40-49	17(13.5)
Level of education	
Diploma	47(37.3)
Degree	79(62.7)
Work experience in years	
<=5	84(66.7)
6-10	34(27)
11-15	8(6.3)
Type health institution	
Health center	38(30.2)
Higher clinic	88(69.8)

6.2 Over all Knowledge towards biosafety measure for TB lab

The overall respondents' knowledge score computed with a maximum of 20 scores. The mean and median score of the respondent were 16.9(20.2%) and 17(10.5%) respectively. Using the mean score as a cutoff point 85(67.5) of laboratory professional had a satisfactory knowledge; the rest 41(32.5%) displayed low levels of knowledge. out of 126 health professionals 28(73.7%) of those working health center and 57(64.8) working higher clinic had satisfactory knowledge.

Regarding the participants knowledge on the premises of TB room, all knew the TB room should be isolated, 91(72.2%) knew separated laboratory bench for receiving and processing specimens are required, 40(31.7%) did not know a hand washing station should be near the lab exit and 97(68.25%) knew Incinerator are constructing in a closed area with brick or concrete walls which is important for waste incineration and most importantly 93(73.8%) of the participant knew directional airflow should be maintained in the laboratory of which 29(31.2%) were from health center and 64(68.8%) were from higher clinic.

In TB AFB laboratory almost all 126(100%) had knowledge on appropriate PPE and fully charged fire extinguisher and fire alarm system should be available in the laboratory. A color coded plastic container like red, black and yellow are required for reagent, noninfectious and infectious respectively. However, 44(34.9%) participants did not know a yellow plastic container is used for disposing sputum cup.

The study revealed that all personnel knew personal protective equipment should be used for each lab procedure but 41(32.5%) did not know the protective equipment should not be used other than the laboratory room. About 95(75.4%) of the participants knew that access should be restricted and biohazard sign should be posted on the lab door. 32(25.4%) of lab professional did not know Aerosol may be created during Sputum cup opening and moving or heat fixing before air drying. Almost all did not know skin test, HIV and radiological facility should be available for the staffs who work with Tb.

The entire participant knows trained personnel, trained cleaner and trained biosafety officer should be available in order to follow appropriate biosafety practice. Figure depicts knowledge of medical laboratory professional towards TB laboratory biosafety.

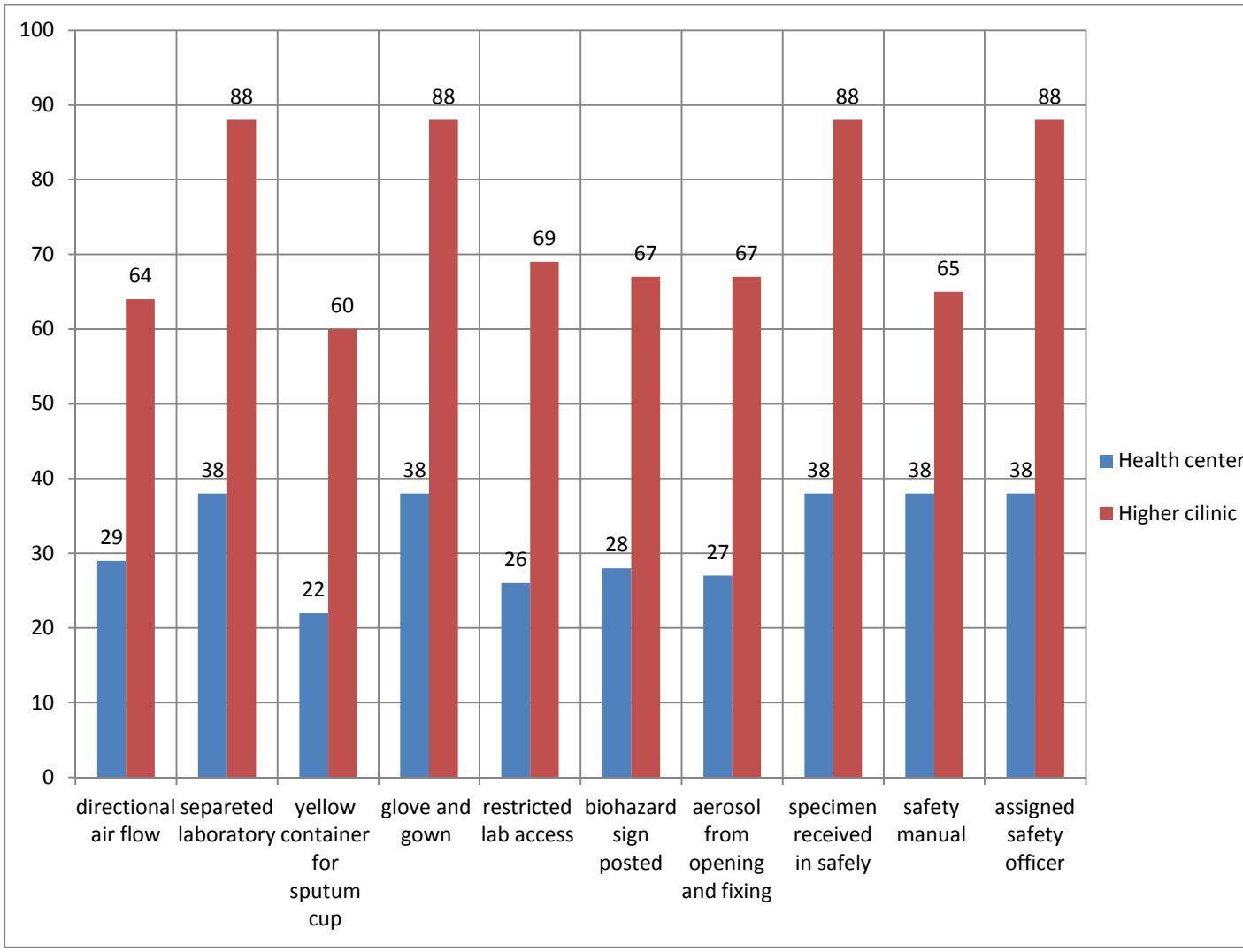

Fig-2 knowledge of laboratory professional who are working on health center and higher clinic

In bivariate logistic analysis diploma holders had statically significant association with low level of knowledge and lab personnel who had degree are 78.9% less likely to have low level of knowledge as compared to diploma holder (OR=0.211,95CI=0.74-0.605,P-value=0.004) (Table 2.)

Table 2: Associations of demographic characteristics of lab professional with level of knowledge at health center and higher clinic, Addis Ababa, Ethiopia 2014

Variables		Level of knowledge					
		Satisfactory No (%)	Low level No (%)	COR(CI)	P-value	AOR(CI)	p-value
Sex	Male	57(67.9)	27(32.1)	1			
	Female	28(66.7)	14(33.3)	1.056(0.480-2.322)	0.893		
Age	20-29	49(62.8)	29(37.2)	4.439(0.947-20.813)	0.059		
	30-39	21(67.7)	10(32.3)	3.571(0.681-18.717)	0.132		
	40-49	15(88.2)	2(11.8)	1			
Level of education	Diploma	40(85.1)	7((14.9)	0.232(0.92-0.580)	0.002*	0.211(0.74-0.605)	0.004*
	Degree	45(57.0)	34(43)	1			
Work experience	<=5	48(57.1)	36(42.9)	5.250(0.618-44.595)	0.129		
	6-10	30(88.2)	4(11.8)	0.933(0.090-9.695)	0.954		
	11-15	7(87.5)	1(12.5)	1			
Type of health institution	Health center	28(73.7)	10(26.3)	1			
	Higher clinic	57(64.8)	31(35.2)	0.657(0.282-1.527)	0.329		

6.3 Attitudes towards TB laboratory biosafety measure

Out of 126 respondents 103(81.7%) were categorized as favorable attitude on the biosafety measure and the rest 23(18.3%) were categorized as unfavorable attitude. It was found that 100 % of lab professional agreed towards availability of separated laboratory room, directional air flow, restricted lab access, biohazard sign on lab door and separated bench for processing and receiving specimens, hand washing station near the lab exit, color coded plastic bug for waste disposal, fully charged fire extinguisher and availability of personal protective equipment. Almost all (100%) had favorable attitudes towards not to move and fix sputum smear until air dried. while only 72(42.9%) disagree towards not using personal protective equipment other than laboratory. However, there was no statically significance association detected between the demographic characteristics with laboratory professional level of attitude ($P>0.05$) (Table 3).

Table 3: Associations of demographic characteristics of laboratory professional with level of attitude at health center and higher clinic Addis Ababa, Ethiopia 2013/2014

Variables		Level of attitude			
		Favorable No (%)	Unfavorable No (%)	COR(CI)	P-value
Sex	Male	70(83.3)	14(16.7)	1	
	Female	33(78.6)	9(21.4)	1.364(0.536-3.470)	0.515
Age	20-29	63(80.8)	15(19.2)	1.111(0.283-4.36)	0.880
	30-39	26(83.9)	5(16.1)	0.897(0.186-4.322)	0.893
	40-49	14(82.4)	3(17.6)	1	
Level of education	Diploma	37(78.7)	10((21.3)	1.372(0.548-3.434)	0.499
	Degree	66(83.5)	13(16.5)	1	
Work experience	<=5	70(83.3)	14(16.7)	1.4(0.159-12.292)	0.761
	6-10	26(76.5)	8(23.5)	2.154(0.229-20.234)	0.502
	11-15	7(87.5)	1(12.5)	1	
Type of health institution	Health center	27(71.1)	11(28.9)	1	
	Higher clinic	76(86.4)	12(13.6)	0.388(0.153-0.981)	0.45

6.4. Practice towards TB laboratory biosafety measure

It was found that most of 73(57.9%) health institution categorized as poor practice on the biosafety measure and 53(42.1%) of them categorized as good practice based on cumulative mean. As shown in Figure 3, only 18 (14.3%) and 19(15.1%) of the health institution had separated laboratory for TB AFB testing and bench for processing and receiving specimens, respectively. So most isolated laboratory room was found in governmental health institution which account 13(72.2%). In this study we observe 17(13.5%) of the health facility had directional airflow in their laboratory and majority of them are governmental health institution.

Regarding the hand washing station, 30(23.8%) of the facility had hand washing station near the lab exit.86(68.25%) of the health facility had brick or concrete walls incinerator and almost all governmental health centers had this type of incinerator but 40(44.2%) of higher clinic had other type of incinerators.(Figure 3).

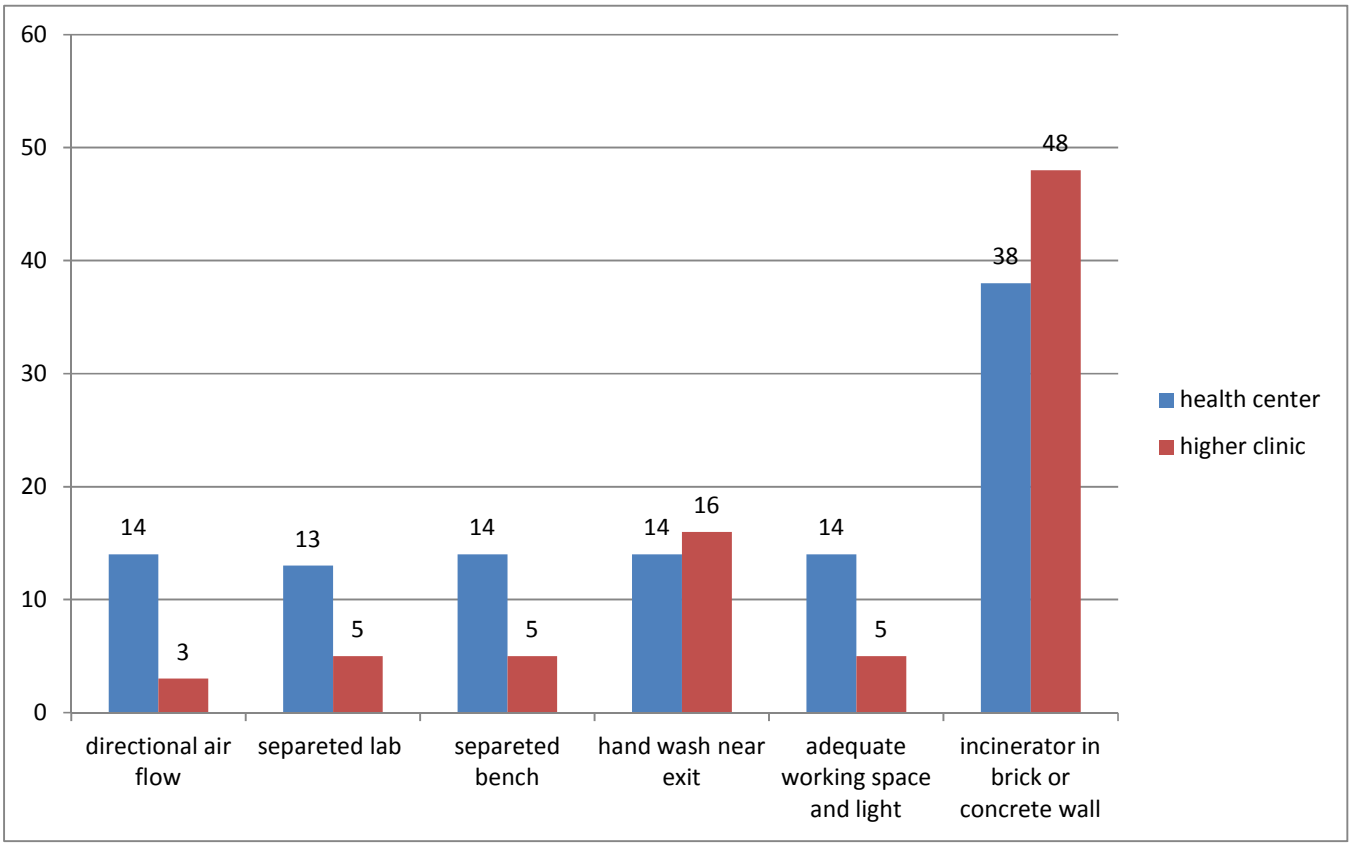

Fig-3 Premises related practice of governmental and private health facility.

All governmental health centers and private higher clinics had appropriate personal protective equipment like gown and glove. But only 15(39.5%) and 14(16%) (55.3%) health centers and higher clinic respectively had fully charged fire extinguisher and fire alarm system. In addition 103(81.7%) of the facility did not have Color coded plastic container for waste disposal and majority of higher clinic 86(83.5%) did not have the container while only 17(45%) of the health centers did not have color coded plastic bug for waste segregation.

Half of the laboratory 63(50%) did not restrict their lab access from unauthorized person from this 45(71.4%) were higher clinic and 18(28.6%) were health center. Only 15(11.9%) of the facility post biohazard sign on their entrance door. Regarding personal protective device, a11 [126(100%)] of the participant used PPE for each procedure but only 43(34.1%) of laboratory personnel are not using PPE like gown other than laboratory.

The study revealed that all personnel receive sputum sample in safe condition but 59(46.2%) of the participant open the sputum cup and smear it in hurry and also fixing before air dried. moreover only 77(61.6%) of the facility disposed infectious material daily and safely (Figure 4).

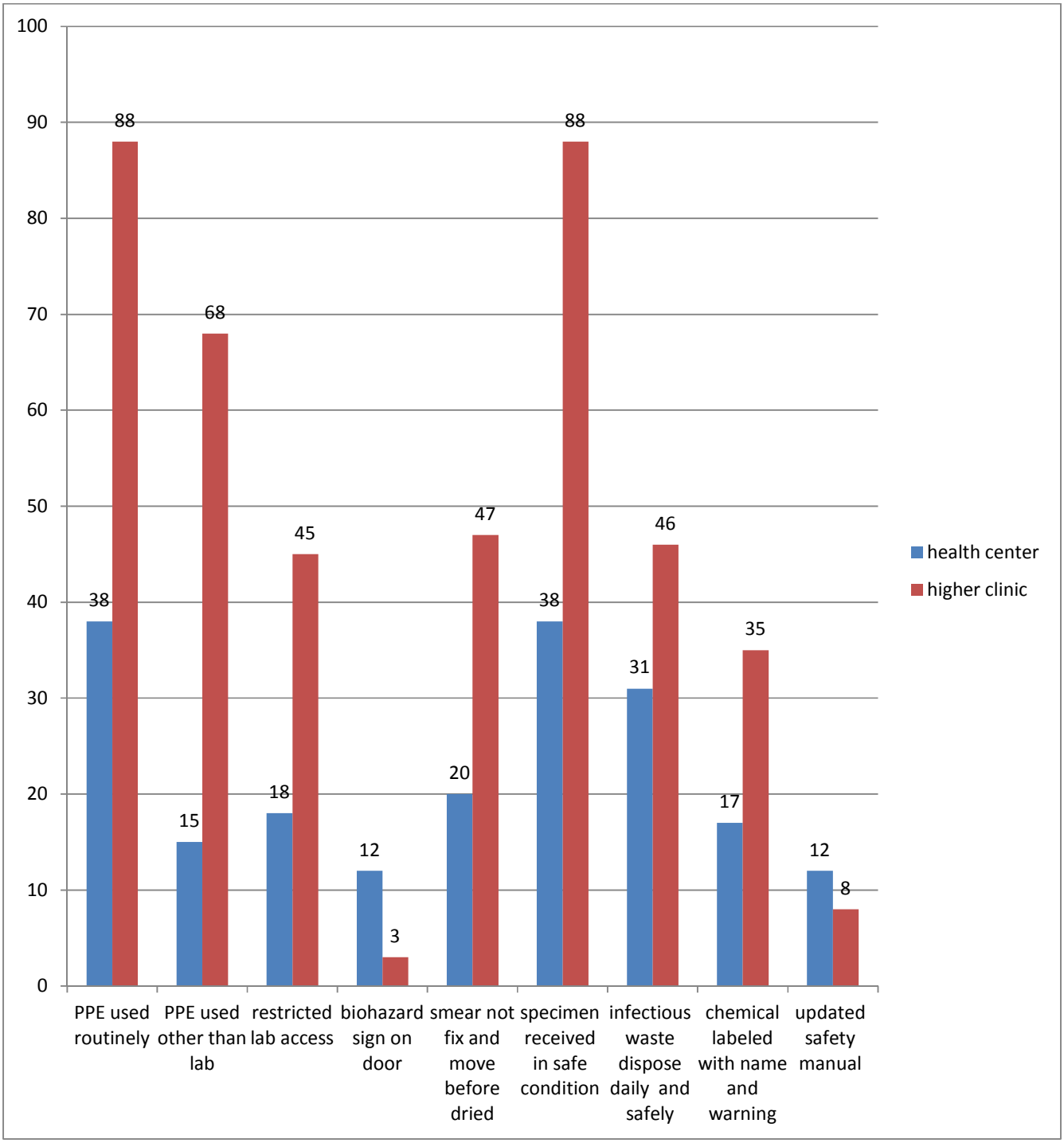

Fig-4 Biosafety related practice of governmental and private health facility.

In this study only 34(27% laboratory personnel had biosafety training and 43(34.1%) non lab personnel had instructed on the potential hazard. Only 32(25.4%) had Trained and assigned safety officer. Moreover 27(30.7%) higher clinic and 16(42.1%) health center instruct non lab worker on potential hazard but only 11(12.5%) and 21(53.3%) of higher clinic and health center assigned trained safety officer respectively. Moreover, 18(47.4%) and 16(18.2%) of health center and higher clinic trained laboratory personnel on Tb biosafety respectively.

In multivariate analysis it was revealed that higher clinic had a significance association with poor practice. Higher clinic contribute 6.951 times increase the application of poor biosafety practice (OR=6.951, 95%CI=2.773-17.424, P-value=0.000) and also lack of trained safety officer. Lack of trained safety officer contribute 8.092 times increase the application of poor practice (OR=8.092, 95% CI=2.939-22.283, P-value=0.000). The same analysis revealed that lack of trained laboratory officer had statically a significant association with the application of poor practice. Lab professional who had training on the biosafety measure are 99.41% less likely to apply poor practice compared to non-trained professional (OR=0.590,95% CI= 0.18-0.194, P-value=0.000), While there was no associate on with sex, age, work experience and level of education. (Table 4).

Table 4. Associations of demographic characteristics of laboratory professional with level of practice at health center and higher clinic Addis Ababa, Ethiopia 2014.

Variables		Level of practice					
		Good practice No (%)	Poor practice No (%)	COR(CI)	P-value	AOR(CI)	p-value
Sex	Male	27(32.1)	57(67.9)	1			
	Female	26(16)	16(38.1)	0.291(1.35-0.63)	0.002*	3.144(1.267-7.803)	0.13
Age	20-29	29(37.2)	49(62.8)	1.183(0.406-3.446)	0.758		
	30-39	17(54.8)	14(45.2)	0.576(0.174-1.909)	0.367		
	40-49	7(41.2)	10(58.8)	1			
Level of education	Diploma	22(46.8)	25((53.2)	0.734(0.354-1.522)	0.406		
	Degree	31(39.2)	48(60.8)	1			
Work experience	<=5	32(38.1)	52(61.9)	1.625(0.380-6.957)	0.513		
	6-10	17(50.0)	17(50.0)	1.000(0.214-4.666)	1.000		
	11-15	4(50.0)	4(50.0)	1			

Type of health institution	Health center	28(73.7)	10(26.3)	1			
	Higher clinic	25(28.4)	63(71.6)	7.056(2.992-16.639)	0.000*	6.951(2.773-17.424)	0.000
Trained safety officer assigned	Yes	25(78.1 %)	7(21.9%)	1			
	No	28(29.8 %)	66(70.2)	8.418(3.264-21.714)	0.000	8.092(2.939-22.283)	0.000
Trained lab personnel	Yes	29(85.3)	5(14.7)	1			
	No	24(26.1)	68(73.9)	0.061(0.21-0.175)	0.000	0.59(0.18-0.194)	0.000

* Statistically significant, CI=95% confidence interval, COR= crude odds ratio, AOR=adjusted odds ratio

7. Discussion:

Laboratory workers are exposed to a number of occupational hazards and dangers daily in their routine work, either physical or- chemical, or biological. There need to be stringent control and regulations not only to maintain the integrity of the workplace but also the safety of an individual worker in the laboratory. A set of rules and regulations for the safety of the laboratory personnel from infectious and other injuries is called biosafety. It also involves instructions for the containment of biological materials and their safe disposal to protect the environment and innocent populations living by from the harmful effects of these germs. Standard microbiological practices and techniques are designed for the purpose of "containment" and are required to be strictly followed by lab workers

The objective of biosafety measure assessment depends on the type of the institute and nature of the work being done. In this study we could see the knowledge, attitude and practice of both governmental health center and private higher clinic on Tb specific biosafety measure.

The knowledge of degree holder laboratory professional had satisfactory knowledge than diploma holder 40(85.1) and 45(57.0) respectively. However the participant generally showed lower knowledge than the study conducted at Addis Ababa University teaching hospitals in Ethiopia in the year 2012(> 90%)(17).

Furthermore the overall knowledge and attitude of the participant was 67.5% and 81.7% which is lower than the study conducted in a teaching hospital at Krishna institute of medical science university in the year of 2013, (100%) (21).

This study demonstrated that there was a practice gap in recommended Tb biosafety measure. Only 42.7% of the participant had good practice on the biosafety measure and majority of the participant had poor practice. Practice were lower than the study conducted in a teaching hospital at Krishna institute of medical science university in the year of 2013, (100%) (21).

Tb biosafety measure states the basic premises which are protective from infection. In our study 86(68.25) of brick made incinerator are available in the health facility and this higher than study conducted in Khartoum state in 2012, 2(1.1%) (19).This could be due to the strength of regulatory body.

On the other hand, in our study 18(14.3) of the health institution had isolated lab and 30(23.8) hand washing sinks and this finding was lower than from the study conducted in Nigeria 2013,(21.3%),(67.5%) (24) respectively. This could be there was no standard which obligate the health facility to isolate their microbiology laboratory.

Fire alarm system and fire extinguisher are one of the product which is recommended in Tb biosafety measure. So, in this study 29(23.0%) of fire extinguisher were available. This is higher than the study from Nigeria in the year 2013, (11.3%) (24).

Regarding on color coded plastic waste containers, this study shows 103((81.7%) of the health facility do not have plastic container for waste segregation in their health facility, and this is higher from the study in India in 2011,(66.7%) (22).This could be lack of supply, training, strong regulation from regulatory body and also there was no standard which may support the regulatory body.

The study observed only 43(34.1%) of non-lab worker were instructed on the potential hazards. This practice is higher than the study conducted in four sub-Saharan (Benin, Cameroon, Cote d'Ivoire, and Togo) countries in 2010, (5.2%) (8). Moreover only 32(25.4%) of laboratory appointed biosafety officer and this shows almost the same result 32(16.8%) of them appoint safety officer in a study conducted in Khartoum in the year 2012 (19). However 92(73%) of them had no biosafety training and this was higher than the study conducted in Pakistan in the year 2012,(84.2%) (22).

Regarding personal protective equipment, in this study all participant [126(100%)] wear glove and gown. So this result are the same with study in Ahmadabad city in the year 2012,(100%) (12).This result also higher than a study in Nigeria 2013, (35%) (24)

Routine use of PPE, biohazard sign on the door entrance and biosafety manual were observed in 126(100%),15(11.9) and 20(15.9) respectively. This result were higher than that reported by the study in Nigeria 2013,(35%),(3.8%) and (1.3%)respectively (24). Almost all participant do not know personal human immunodeficiency virus (HIV) status like the study in rural south Africa hospital in 2011,(18).

8. Strengths:

The good quantitative study design, cross sectional for KAP study, is used. High response rate was the other one, which could be as a result of making the data collectors from the regulatory body. The other strength was sampling method and procedure used. It was targeted to decrease selection bias.

9. Limitation

Since it was a KAP study, there is no gold standard to measure TB knowledge which made the comparison of the finding with other studies somewhat difficult, therefore this should be considered during the comparisons .We are unable to include all sub city and also moderate and high risk Tb laboratory. This limits our finding only on low risk TB laboratory which is Tb AFB.

10. Conclusion and Recommendation

Knowledge and attitude with Tb biosafety measure among laboratory workers is good. Suggestions to improve deficiencies identified include elaborate training on Tb biosafety measure, commitment to safer work practices by health institution management. In laboratory awareness about safety should be increased among staff members. Laboratory safety has to be a part of the overall quality assurance program in health institution.

In order to ensure biosafety practices, there is direct need to develop SOPs and to encourage not using of Personal Protective Equipments (PPEs) out of laboratory. Institutional biosafety support for effective waste segregation and disposal. Regular training on biosafety principles for lab worker and non-lab worker in order to follow recommended measure along with the appointment of a biological safety officer to oversee the proposed work activities, procedures, equipment, personnel, storage, material transfer and transport, and proper destruction of biological material. This officer should indicate risk analyses and develop written standard operating procedures for the laboratories.

There should be a strong registration system for laboratories at the national level. Before issuing a license to any laboratory, proper evaluation and inspection should be performed to examine laboratory design, proper ventilation, entrance and exit, by experts to ensure laboratory biosafety. Finally, a further study is worth to support and strengthen the findings specially on moderate and high risk Tb laboratory.

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Annexes

Annex-I

English version of Information sheet, Consent and Questionnaire

Participant information sheet:

School of Medical Laboratory Sciences, Collage of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia

Title: Assessment of knowledge, attitude and practice of laboratory personnel towards the biosafety measure for tuberculosis testing laboratory in selected health institution in Addis Ababa, Ethiopia.

First of all we would like to thank you in advance for your cooperation and consent in participation in this study. Please read or listen when it is read for you about the general information of the study. If you have any question about the study, don't hesitate please we are happy to answer**.**

Background Information Background: Transmission of tuberculosis in health care settings to both patients and health care workers has been reported from virtually every country of the world and Tb is the second leading cause of death from an infectious disease worldwide, after the human immunodeficiency virus. It is caused by *Mycobacterium tuberculosis* and is transmitted mainly through aerosolization of infected sputum which puts laboratory workers at risk in spite of the laboratory workers' risk of infection being at 3 to 9 times higher than the general public. Laboratory safety should therefore be prioritized and optimized to provide sufficient safety to laboratory workers**.**

Aims Of the study: This study will be conducted to assess knowledge, attitude and practice of laboratory personnel towards the biosafety measure for tuberculosis testing laboratory in selected health institution in Addis Ababa, Ethiopia.

Benefits of the Study: Study participants will not have any financial incentives or other inducements from participating on this study. Most importantly, this study will contribute to provide updated information or data for the nationwide study and for policy maker to develop standard for health facility**.**

Confidentiality: name will not be given and the samples will be coded. Participants will not be prohibited to stop or withdraw at any time from the study. Only interested participants can retrieve their own lab result using their code number, and the information can only be accessed through the physician. The physician will be responsible for the interpretation of the results and providing treatment. No personal information will be disclosed to third party or will not appear in any report from this study.

Assurance of Principal Investigator: I put my signature below to confirm you that I take over the responsibility for the scientific ethical and technical conduct of the research project and for provision of progress reports for all stakeholders of the research project.

Henok Birhanu (PI)

Signature: _____ Date: _____

Note: If you have any questions about this study, you should feel free to ask now or anytime throughout the study by contacting:

PI Address: Henok Birhanu: School of Medical Laboratory Sciences, Collage of health sciences, Addis Ababa University, Addis Ababa, Ethiopia

E-mail: birhanuhenok68@yahoo.com; **Tel :** +25193462723

Written Consent Form:

I_____. I am a third year post graduate student in Addis Ababa University, College of Health Science, and School of Medical Laboratory in Laboratory Management and Quality Assurance Track. Here, we are intending to assess knowledge, attitude and practice of laboratory personnel towards the biosafety measure for tuberculosis for this, I need you to answer my questionnaires. It will be my pleasure if you are volunteer to participate in this particular study. The information in your response is strictly confidential. Your participation in this study is completely voluntary and you can refuse to participate. Do you understand what has been said to you? If not, you have the right to get proper explanation. This consent form has been readout to me in my own language, and I understand the content and I am voluntarily consent to participate in the study.

Study Area _____

Name _____ Signature _____ Date _____

Wittiness Name _____ Signature _____ Date_____

Investigator Name _____signature _____ Date___

Questioners:

Questionnaire is designed for a descriptive study on knowledge, attitude and practice of lab. Personnel towards the biosafety measure for Tb testing laboratory in Addis Ababa selected health institution

Addis Ababa University

Facility of medical

School of medical laboratory science

This questionnaire is designed for a descriptive study on knowledge, attitude and practice of lab. Personnel towards the biosafety measure for Tb testing laboratory in Addis Ababa selected health institution

Dear respondents

This questionnaire is prepared to collect data on KAP (knowledge, attitude and practice) of lab. Personnel towards the biosafety measure for Tb testing laboratory to prevent lab. Acquired infection. It is purely for the improvement of safety practice. You don't write your name on this paper. Your cooperation is highly appreciated. Write you response according to the instruction given below.

ID (code No) _____

I. Social demographic characteristics

1. Gender Male ☐ Female ☐
2. Age 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ >60 ☐
3. Level of education a).diploma and blow, b, Degree, c, MSC
4. Work experience in years a) <=5 b) 6-10 c)11-15 d)>15
5. Where do you work?
   - 5.1. Health center ☐
   - 5.2. Higher clinic ☐

Knowledge assessing question

No	KNOWLEDGE ASSESSING QUESTION	Applicable to risk level…	YES	NO	NO RESPONSE
	PREMISES				
1	Do you know The air flow should be from clean areas towards areas where aerosols maybe generated and discharged from the room safely	ALL	1	2	3
2	Do you know The laboratory should be separated from the areas that are open to unrestricted traffic flow within the building?	ALL	1	2	
3	Do you know separated bench should be used to process and receive Specimens and also from administrative areas used for paperwork and telephone?	ALL	1	2	3
4	Do you know A hand washing station should be provided near the laboratory's exit?	ALL	1	2	3
5	Do you know The working space and light should be adequate for safe operation?	ALL	1	2	3
6	Do you know The health facility should incinerator for waste incineration?		1	2	3
	PRODUCT				
1	Do you know yellow plastic bug should be used for discarding sputum cup?	ALL	1	2	3
2	Do you know The laboratory should have a fire alarm system and portable fire extinguishers maintained fully charged and in working order, and kept in designated places at all times?	ALL	1	2	3
3	Glove, apron and Gown are recommended personal protective device for Sputum Smears Microscopy?	ALL	1	2	3
	PRACTICE				
1	Do you know the Laboratory access should be restricted to authorized personnel only?	ALL	1	2	3
2	Do you know Biohazard sign should be posted on laboratory door?	ALL	1	2	3

3	Do you know Any protective clothing should not be used other than the laboratory?	ALL	1	2	3
4	Do you know Aerosol may be created during Sputum cup opening or moving and heat fixing before air dried?	ALL	1	2	3
5	Do you know Skin test, HIV test and/or radiological facilities should be available for staff who Work with tuberculosis materials?	ALL	1	2	3
6	Do you know Infectious materials should be discarded daily and safely?	ALL	1	2	3
7	Do you know Chemicals should be correctly labeled with name and warning?	ALL	1	2	3
8	Do you know Tb specific and revised biosafety manual should be available?	ALL	1	2	3
	PERSONNEL				
1	Do you now Laboratory personnel should have trained to follow appropriate biosafety practices?	ALL	1	2	3
2	Do you know Non-laboratory workers, like cleaner, should be instructed on the potential hazards of the laboratory?	ALL	1	2	3
3	Do you know The laboratory should have assigned safety officer?	ALL	1	2	3

Attitude Assessing Question

No	ATTITUDE ASSESSING QUESTION	Agree	Disagree	NO RESPONSE
	PREMISES			
1	Do you think directional air flow helps to protect laboratory personnel from infection?	1	2	3
2	Do you think Tb lab should be separated from the areas that are open to unrestricted traffic flow within the building?	1	2	3
3	The bench used to process specimens separated from areas used to receive Specimens and from administrative areas used for paperwork and telephone?	1	2	3
4	A hand washing station provided near the laboratory's exit?	1	2	3
	PRODUCT			
1	Do you think color coded plastic bug is important for waste segregation?	1	2	3
2	Do you think fire alarm system and portable fire extinguishers should be available?	1	2	3
3	Do you think Personal protective device (PPD) like glove and gown should be available?	1	2	3
	PRACTICE			
1	Laboratory access should be restricted to authorized personnel only?	1	2	3
2	Biohazard sign should be posted on laboratory door?	1	2	3
3	Personal protective device (PPE) used for each lab procedure like glove and gown?	1	2	3
4	Do you think Any protective clothing is not used other than the laboratory?	1	2	3
5	Do You think Sputum cup should open slowly and the Sputum smear do not move or heat-fix until they have been completely air-dried	1	2	3
6	Skin test, HIV test and/or radiological facilities available for staff who Work with tuberculosis materials?	1	2	3
7	The work benches kept clean, tidy and specimen should be	1	2	3

	received in a safe condition?			
8	Do you think Chemicals correctly labeled with name and warning?	1	2	3
9	Do you think Infectious materials discarded daily and safely?	1	2	3
10	Do you think Tb specific and revised biosafety manual should be available?	1	2	3
	PERSONNEL			
1	Do you think Laboratory personnel should have training to follow appropriate biosafety practices?	1	2	3
2	Do you think Non-laboratory workers, like cleaner, instructed on the potential hazards of the laboratory?	1	2	3
3	Do you think The laboratory should have designated safety officer?	1	2	3

Practice assessing questions

No	PRACTICE ASSESSING QUESTION	Applicable to risk level…	YES	NO	NO RESPONSE
	PREMISES				
1	The air flowing from clean areas towards areas where aerosols maybe generated and this air should be safely discharged from the room	ALL			
2	The laboratory separated from the areas that are open to unrestricted traffic flow within the building?	ALL			
3	The bench used to process specimens separated from areas used to receive Specimens and from administrative areas used for paperwork and telephone?	ALL			
4	A hand washing station provided near the laboratory's exit?	ALL			
5	The working space and light are adequate for safe operation?	ALL			
6	Does The lab have incinerator?				
	PRODUCT				
1	There are color coded plastic bug for the collection and disposal of waste?	ALL			
2	The laboratory a fire alarm system and portable fire extinguishers maintained fully charged and in working order, and kept in designated places at all times?	ALL			
3	Personal protective device (PPD) like glove and gown are available?	ALL			
	PRACTICE				
1	Laboratory access should be restricted to authorized personnel only?	ALL			
2	Biohazard sign should be posted on laboratory door?	ALL			
3	Personal protective device (PPD) used for each lab procedure like glove and gown?	ALL			
4	Any protective clothing is not used other than the laboratory?	ALL			
5	Sputum cup open slowly and the Sputum smear do not move or heat-fix until they have been completely air-dried	ALL			

6	Skin test, HIV test and/or radiological facilities available for staff who Work with tuberculosis materials?	ALL			
7	The work benches kept clean, tidy and specimen should be received in a safe condition?	ALL			
8	Infectious materials discarded daily and safely?	ALL			
9	Chemicals correctly labeled with name and warning?	ALL			
10	Tb specific and revised biosafety manual is available?	ALL			
	PERSONNEL				
1	Laboratory personnel have trained to follow appropriate biosafety practices?	ALL			
2	Non-laboratory workers, like cleaner, instructed on the potential hazards of the laboratory?	ALL			
3	The laboratory has designated safety officer?	ALL			

Declaration

I the undersigned, declare that this proposal is my original work, has never been proposed in this or any other university, and that all resources and materials used herein, have been duly acknowledged.

Principal Investigator

- Name: Henok Birhanu (BSc.)
- Signature: _____
- Date of submission_____

Advisors

This proposal has been submitted with my approval as a University advisor.

- Name: Mr. Mistre wolde (BSc, MSc and PhD candidate)
- Signature _____Date_____
- Address: E-mail;
- Tel: 0911699710