KNOWLEDGE, ATTITUDE AND COMPLIANCE TO BIOSAFETY GUIDELINES AMONG MEDICAL LABORATORY SCIENTISTS IN IBADAN METROPOLIS, OYO STATE

BY

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DEDICATION

This project is dedicated to the blessed memory of my beloved Daddy, Mr. Olaoye Raji Sanusi for the care, understanding and sacrifices he made for me during his lifetime. May his gentle soul rest in perfect peace.

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ABSTRACT

Several laboratory-associated infections have occurred in different parts of the world involving both known and previously unknown agents. Many of these cases in Africa, including Nigeria have been linked to improper containment and poor disposal for infection control. Several laboratory scientists have high knowledge of biosafety but low attitudinal compliance to biosafety. Hence the research was designed to assess the knowledge and attitudinal compliance of biosafety of laboratory scientists in Ibadan, Oyo State.

This study was a descriptive survey that used purposive sampling to select 250 medical laboratory scientists from all available public and private registered medical laboratories in Ibadan metropolis. A pretested semi-structured self-administered questionnaire which contained 21-point knowledge scale, 13–point attitudinal scale and 42-point compliance scale, questions relating to issues affecting compliance to laboratory biosafety guidelines among medical laboratory scientists was used for data collection. Knowledge scores 0-7, >7 ≤ and >14 were classified as poor, fair, and good, respectively. Similarly, Attitude scores 0 – 6 and >6 were categorized as negative and positive attitude, respectively and compliance scores 0 – 20 and > 20 > 42 were categorized as low and high compliance, respectively. The data were analyzed using descriptive statistics, Chi-square test and Fishers exact test at p=0.05.

Result obtained showed that respondents' age was 40.0 ± 8.1 years, majority (71.0%) were married and Yorubas (97.8%). About half of the respondents (50.2%) were males and majority (52.4%) spent 8 hours at work. Knowledge score was 16.1± 4.7; respondents with poor, fair and good knowledge of laboratory biosafety guidelines were 10.0%, 9.6%and 80.4% respectively. A high proportion (79.0%) had positive attitude while 21.0% had negative attitude towards laboratory biosafety guidelines. Almost all the respondents (91.2%) had low level of compliance. Chi-square test showed that the attitude of the respondents is significantly associated with their knowledge of biosafety guideline and that the gender of the respondents is significantly associated with their level of compliance. Fisher's Exact test also showed significant association between knowledge and compliance to biosafety guidelines. Chi-square test showed no statistically significant association between age and compliance to biosafety guidelines. Inadequate supply of gloves, lack of hand washing station, inadequate supply of water, lack of occurrence register were some of the issues relating to the compliance of laboratory biosafety guidelines by the scientists.

The respondents' knowledge and attitude to laboratory biosafety guidelines were good. However, the compliance was poor due to some factors. Updated trainings to sustain the knowledge and attitude and to raise the compliance level should be designed for the scientists.

Key words: Biosafety, compliance, personal protective equipment, medical laboratory scientist

Word Count: 414

CERTIFICATION

I certify that this work was carried out by in the Department of Health Promotion and Education, Faculty of Public Health, College of Medicine, University of Ibadan, Ibadan, Nigeria.

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GLOSSARY OF ABBREVIATIONS

QMS	Quality Management Systems
MLSCN	Medical Laboratory Science Council of Nigeria
WHO	World Health Organization
MDGs	Millennium Development Goals
ISO	International Organization for Standardization
HIV	Human immunodeficiency virus,
HCV	Hepatitis C Virus
HBV	Hepatitis B virus
BBPs	Blood-borne pathogens
BSL	Biosafety Level

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Medical laboratory science is defined by Medical Laboratory Science Council of Nigeria (MLSCN) Act as the practice involving the analysis of human or animal tissues, body fluids, excretions, production of biological, design and fabrication of equipment for the purpose of medical laboratory diagnosis, treatment and research"(Muhibi, 2010; MLSCN, 2003). The importance of quality control in the functions of health care laboratories is a global issue; more importantly in developing countries (Kusum& Silva, 2005).The World Health Organization (WHO) recognizes quality laboratory services as means of improving global health and reaching Millennium Development Goals (MDGs). Crucial to this, is strengthening the breadth of laboratory services accessible to clients and ensuring that results are accurate, reliable, reproducible, and rapid enough to be useful (MLSCN, 2012).

The International Organization for Standardization (ISO) has developed quality systems to assess specific aspects of health services. A majority of laboratories rely on International Quality Standards known as ISO/IEC/17025 for all types of testing and calibrating laboratories and more specifically ISO 15189 for medical laboratories(Kusum& Silva, 2005). In Nigeria, the Medical Laboratory Science Council of Nigeria (hereinafter referred to as 'Council') under section 4(h) and 19(d) of MLSCN Act, 2003 is mandated to inspect, approve, monitor and accredit Medical Laboratories in the country. Council accreditation is a validation process established to ensure that Medical Laboratories deliver high quality services that meet the needs and requirements of their clients. It also promotes competence and strict compliance with quality control, health and safety guidelines in all the activities carried out in the laboratories.

Every day, workers in laboratories are generally faced with many occupational risks that may severely jeopardize his/her health and safety if adequate preventive and protective measures are not taken. The prevention of occupational hazards in laboratories requires a thorough knowledge of the risks and practical measures to be taken. Laboratory workers are expected to familiarize themselves with "universal work precautions," defined by Center for Disease Control as a set of precautions designed to prevent transmission of Human immunodeficiency virus (HIV), hepatitis B virus (HBV), and other blood borne infections when providing first aid or health care. Universal work precautions involve the use of protective barriers such as gloves, gowns, aprons, masks, or protective eyewear, which can reduce the risk of the health care worker's skin or mucous membranes to potentially infective materials (Muhibi, 2010).

In past few years in Nigeria, there has been report of unethical medical laboratory science practice (Okonkwo, 2010) which needed to be prevented if breaching biosafety guidelines and quality control in laboratories will be curbed. Accreditation of medical laboratories on the basis of work competence and fulfillment of specified assessment criteria is therefore necessary to discourage the worst of quackery and/or professional malpractices in medical circles with attendant consequence of misleading other members of the health team. Establishing quality health system in the country therefore needs high level of adherence to laboratory biosafety guidelines.

1.2 Statement of the Problem

Quality and safety, particularly laboratory biosafety, are of paramount importance in health laboratories. Reliable results produced by a laboratory improve the decision making capacity of the clinicians as well as public health physicians. The consequences of poor quality could be serious. It could lead to inappropriate action or action leading to over treatment, over-investigation or mistreatment, lack of treatment or inadequate investigations. Delayed or suboptimal responses as a result of poor quality of laboratory services could adversely affect the credibility of the laboratory and may also invite legal action(Kusum and Silva, 2005).

Laboratory biosafety has been described as the containment principles, technologies, and practices implemented to prevent unintentional exposure to pathogens and toxins or their accidental release (WHO, 2006). Several laboratory-associated infections have occurred in different parts of the world involving both known and previously unknown agents (Gaudioso and Zemlo, 2007). Use of protective clothing and safety gadgets alone may not guarantee the safety of the laboratory personnel. There should always be a combination of policies and systems to protect the laboratory workers from the risk of laboratory-associated infections. Improper containment and poor disposal of biomedical wastes is a potential source of infection to health care workers, patients, and the community at large (Hegde *et al*., 2007).

However, studies have indicated that most laboratories in developing countries, especially those in Africa, have rudimentary and highly compromised infection control programs owing to the lack of awareness of the problem, lack of personnel trained in infection control practices, inadequate and aging infrastructure, irregular supply of gloves, masks, and disinfectants and poor laboratory backup (Samuel *et al*., 2010). The situation in private and public clinical diagnostic laboratories that constitute an integral part of most hospitals in Nigeria is unlikely to be any different. According to the report of Council, majority of public health laboratories in Nigeria delivered suboptimal services. Many performed poorly, hindered by dilapidated infrastructures, poor development and implementation of Quality Management Systems (QMS), including inadequate participation in External Quality Assessment (EQA) programs(MLSCN, 2012).

The World Health Organization (2005) reported that among the 3.5 million health workers worldwide, about 3 million sustain percutaneous exposures to blood borne pathogens each year, 2 million are exposed to hepatitis B virus (HBV), 0.9 million to hepatitis C virus (HCV) and 170,000 to human immune deficiency virus (HIV). These injuries may result in 70,000 HBV, 15,000 HCV and 5,000 HIV infections. Worrisome, more than 90% of these occupational infections occur in developing countries, where Nigeria is a part. In additions, risks and hazards associated with healthcare waste are also great. Eighty percent (80%) of healthcare waste is general waste or low risk waste, 20% can be dangerous and referred to as high risk waste while 1% of risk waste is sharps waste. These are consequences of laboratories' inability to comply with quality control measures and biosafety guidelines in the delivery of their services.

1.3 Justification of the Study

Preparation of patients for operative procedures in Nigeria does not routinely include screening for HBV and HCV but may include screening for human immunodeficiency virus (HIV). Laboratory workers may often be unguarded when attending to patients who are negative to HIV and this places the worker at a higher risk of HBV and HCV infection. Therefore, the adoption of universal and consistent safety practices is important in reducing these occupational infections, considering their role in preventive, diagnostic, therapeutic and referral services at all levels of health care delivery. The standard guidelines already launched by ILO, WHO and the Joint United Nations Programme on HIV/AIDS (UNAIDS) in 2010 are to address the gap in the health care industry which makes the HCWs such as doctors, nurses and midwives, technical staff such as pharmacists and laboratory scientists, as well as health managers, cleaners, security guards and other support workers working in areas of high prevalence of HIV and TB at risk of occupational hazards due to lack of adequate access to protection and treatment (WHO, 2010, Accessed September 5, 2015). There is dearth of information regarding compliance with these measures and standard service requirement as suggested by Medical Laboratory Science Council of Nigeria (MLSCN) among laboratory scientists in Nigeria. And the low level of compliance to biosafety guidelines as standard laboratory requirement for Nigeria can create lapses in practice which could lead to wrong diagnosis and wastages of limited financial resources. Most previous studies in Nigeria have focused more on the knowledge and compliance of health workers to standard precautions. Knowledge, attitude and compliance to biosafety guidelines among laboratory scientists has not been properly explored and thus the justification of this study.

Considering that compliance to laboratory service standard is the primary prevention of occupational exposures and reducing occupational risk of infection with blood borne pathogens as well as other means of infection and accidents,this study will significantly contribute to knowledge in the following ways: The results from this research will identify the level of awareness of biosafety guidelines among the laboratory scientist. It will also reveal the factors that affect the compliance of the biosafety guidelines and as such serve as evidence for re-orientating the laboratory scientist on the need for adoption of the laboratory policy. In addition, the study will serve as feedback to the policy makers for the amendment of laboratory policy.

1.4 Research Questions

The study has the following research questions:

1. What is laboratory scientists' level of knowledge on biosafety guidelines?
2. What is laboratory scientists' attitude towards biosafety guidelines?
3. What is the level of compliance to biosafety guidelines among laboratory scientists?
4. What are the factors affecting compliance to biosafety guidelines among laboratory scientists?

1.5 Broad Objective of the Study

The broad objective of this study is to investigate the knowledge, attitude and compliance with biosafety guidelines among medical laboratory scientists in Ibadan

1.6 Specific Objectives of the Study

The specific objectives of this study are as follow:

1. To assess the knowledge on biosafety guidelines among medical laboratory scientists
2. To examine attitude towards biosafety guidelines among laboratory scientists.
3. To determine the level of compliance to biosafety guidelines among laboratory scientists
4. To assess factors affecting compliance level to biosafety guidelines by laboratory scientists

1.7 Research Hypotheses

The null hypotheses are as follows:

1. There is no association between level of compliance and age and sex of the scientist.
2. There is no association between knowledge and attitude of laboratory scientist

3. There is no association between the knowledge of the respondents and their compliance to laboratory biosafety guidelines

CHAPTER TWO

LITERATURE REVIEW

2.1 Laboratory activity and procedure

Analysis of human and animal samples for disease diagnosis, epidemiological studies, scientific research and therapeutically developments constitute all the activities undertaken in a medical laboratory. Biological materials are manipulated in laboratories for numerous for genuine and justifiable purposes ranging from educational, scientific research, medicinal and health-related to mass commercial and industrial production. Major proportion of laboratory procedures involves handling infectious biological materials and daily exposure to dangerous pathogens every day. Human error, poor laboratory techniques and misuse of laboratory equipment leads to accidents, injuries and work-related infections in the laboratory. As such it is impertinent for laboratory workers and/or staffs to observe safe laboratory procedures. All laboratory staffs are expected to have knowledge of safe and standard laboratory procedures and as well be aware of associated hazards. Adherence and compliance to standard biosafety guidelines would prevent serious infections and protect the healthcare system (WHO, 2006).

2.2 Risk of Infection in the Laboratory

The World Health Organization (WHO) developed a system to classify microorganisms based on their danger to laboratory staff and the public (World Health Organization (WHO), 2004). Biological agents of risk group 1 include those unlikely to cause disease in man, Biological agents of risk group 2 include those that can cause disease in humans and pose dangers to workers with little chance of spreading among them or to the community, Biological agents of risk group 3 include those that can cause serious illness in humans, represent a serious danger to workers with risk of spreading to the community, and finally, the biological agents of risk group 4 include those that can cause severe disease in humans and represent a serious danger to workers, with likelihood of being spread to the community. Although, risk groups 2 and 3 may have effective treatment and prophylaxis, there is usually no effective prophylaxis or treatment for risk group 4 (World Health Organization, 2004).

In laboratories, there are many tasks that involve numerous risks to the laboratory staff (Szadkowska-Stanczyk, 2010). Laboratory workers are at an increased risk of occupational exposed to a large pool of specimens from patients suffering from infections such as hepatitis B virus (HBV) and HIV (Izegbu*et al.*, 2006). Exposure can occur through a percutaneous injury and/or mucosa exposure (needle-stick or other sharps injury), a mucocutaneous occasion (splash of blood and body fluids into the eyes, nose, or mouth), or blood contact with damaged skin. This presents a major risk for the transmission of blood-borne pathogens (BBPs) such as HIV, HBV, hepatitis C virus (HCV) (Mortada and Zalat, 2013), and recently Ebola.

According to world health organization (WHO), 2.5% of HIV cases, 40% of both HBV and HCV cases worldwide are the result of occupational exposure among health care workers(Assiri *et al.*,2013) and the risk of seroconversion following a needle-stick injury from an HCV-antigenpositive patient is estimated to range from 1.2% to 10% (Muzuno, 1997) . The incidence rate of these causative factors is higher in developing countries for the higher rate of injection with previously used syringes. Developing countries which also include Nigeria where the prevalence of HIV infected patients is very high, record the highest needle stick injuries as the most common occupational health hazard in a teaching hospital (Vaz andMcgrowder, 2010). Ejele and Ojule, (2003) reported 8.1% risk of occupational exposure to HIV infection and 14.8% to hepatitis among medical laboratory workers in Port Harcourt, Nigeria.

Health workers especially those in the Laboratory are frequently exposed to infection agents during specimen and sample test which can be detrimental to their health and their community. Several laboratory-associated infections have occurred in different parts of the world involving both known and previously unknown agents. Hospitals and diagnostic laboratories are at the forefront of disease detection in Nigeria. They are expected to have the capacity to handle and detect known or unknown (novel) biological agents. Although diagnostic laboratories are important in the fight against infectious diseases, laboratory workers are generally faced with many occupational risks that may jeopardize their health. However, they seem to have a poor perception of the risk of infections and are not compliant with the basic principles of universal precautions.

In the current urgent demand for new vaccines against extremely hazardous pathogens such as Ebola, Levine *et al*., (2014) call for research that involve the manipulation of pathogenic microorganisms that could have harmful effects on public health and the environment. This system of infection control is, therefore, very important if the risk of transmission of infections in the laboratory is to be minimized. And to guarantee the biosafety of laboratory staff, as they may not be aware of the outcome of blood and fluid specimens until they are investigated or contaminate instruments in the laboratory, there is need to enacting observance of and compliance to standard and safe laboratory procedures (Wader *et al*., 2013).

2.3 Transmission from Patient to Health Care Workers

Hepatitis B virus (HBV) and hepatitis C virus (HCV) infections are among the commonest occupational risks healthcare workers are exposed to (Krawczyk *et al*., 2010). The infections are acquired in the hospital setting via needle prick injuries from contaminated needles, eye contact of infected body fluids or from contact of infected body fluids with broken skin. Among the health care workers, theatre and laboratory staffs are said to be at a risk of infections from their contact with infected materials and patients (Krawczyk *et al*., 2010).

Adoga *et al*., (2010) reported a 6% prevalence of HBV in a Nigerian population with the highest infectious rate observed among those aged 21-30years. In Uganda, 8.1% of health care workers were reported to be seropositive to HBV with 67.8% prevalence of needle stick injuries and 41.0% prevalence of exposures to mucous membranes such as the eyes (Ziraba *et al*., 2010). Another study in Pakistan showed that the prevalence of HBV and HCV infection among health care workers was 6.0% and 5.4% respectively (Bosan *et al*., 2010). While 2.18% of health care workers in Pakistan were seropositive to HBV, nurses and technicians were the most prone to occupational exposure to HBV, thus, indicating the seriousness of transmission from patients to health care workers and vice visa (Attaullah*et al*., 2011). Interestingly, the use of gloves have been demonstrated to reduce infection, however their use among healthcare workers is inconsistent and may be influenced by risk perception and health care culture (Attaullah *et al*., 2011).

2.4 Knowledge and Practice on Biosafety among Health care workers

Biosafety is not only comprised of the protective practices in response to the contamination risks associated with pathogenic microorganisms in the laboratories, manipulation of potentially contaminated stock or products, performance of microbiological tests for medical or scientific purposes, but also the measures observed in protecting the environment and the human population against potential contamination (Ionescu *et al*., 2007). It is based on the combined impact of good microbiological techniques, facility design of the laboratory and safety equipment (Charlie *et al*., 2015). Laboratory hazards can be physical, chemical and biological. The prevention of occupational hazards in laboratories requires a thorough knowledge of the risks and practical measures being taken (Zaveri and Karia, 2005). Adequate knowledge is thus imperative for laboratory standard and biosafety precautions among laboratory workers. The Knowledge, training and teamwork are required to obtain adequate specimens for testing and to ensure correct processing, handling, storage, analysis and reporting and also to protect the laboratory staff involve (El-Nagen *et al*., 1992).

Report on attitudes, perception and practice of workers in laboratories in the two colleges of Medicine and their teaching hospitals in Lagos State, Nigeria as regards universal precaution measures showed that all the 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. While 45.6% of the participants eat in the laboratory, 47.0% of them store foods and water in the refrigerators meant for storage of body fluids and chemical, 31.5% of them put on cosmetics in the laboratory, 12.6% smoke and sniff in the laboratory, 10.0% cut their finger nails with teeth and put their biros in their mouths in the laboratory, 36.5% do not know that tissues fixed in formalin can transmit infections, 91.5% are not immunized against hepatitis B virus (HBV), 99.0% of them do not take shower immediately after laboratory work and 82.0% of the participants do not feel that the use of masks is necessary in laboratory. It was concluded that the knowledge, attitude, perception, and compliance with universal precautions among these highly exposed laboratory workers are poor (Izegbu *et al*., 2006).Similar to these were obtained in 2009 in a cross-sectional study in Gatlodia, Ahmedabad among laboratory technicians regarding universal work precaution. Only technicians directly involved with the work in the laboratories of selected hospitals participated in the study (Zaveri and Karia, 2005). In Nigeria, a study in North Eastern area revealed that about one third (32%) agreed that blood and body fluids from all patients are potentially infectious irrespective of their diagnostic status, while 63.2% believed that only those diagnosed were infectious. Only 4.6% believed that those suspected of being infected are potentially infectious. The study concluded that Half (50%) of the respondents reported no knowledge of universal precautions; more than one third (37%) had average knowledge of universal precautions while 13% had good knowledge (Abdulraheem *et al*., 2012). In Karachi, Pakistan, a study conducted on a population of health care workers revealed low knowledge in biosafety and proper disposal of health waste. Moreover, majority of the health care workers reported that they were not provided with proper facilities for handling infectious wastes (Nashim *et al*., 2008).

The attitude and practices of the laboratory health workers towards universal Precaution call for a lot of concern as increased unethical practices abound in most medical laboratories (Zaveri and Karia, 2005). Standard Precaution measures are composed of key elements such as hand hygiene, wearing gloves, facial protection (goggles, mask), gown, prevention of injuries from needle stick and other sharp instruments. They also include other elements such as waste disposal, environment cleaning, linens handling and patient care equipment. A study conducted in Abuja, Nigeria, by Okechukwu and Motshedisi, (2012) reported the knowledge and practice of these standard precaution measures among laboratory staff. Biosafety among laboratory scientist is an important aspect and needs to be addressed. It encompassed determining the knowledge, attitude, and practice of universal precautions among medical laboratory workers.

Addressing occupational safety, a study in India, assessing awareness of occupational safety measures such as universal precautions, biomedical waste handling, disposal and its compliance in their daily practice reported 27 (32%) nurses and 20 (57%) laboratory technicians could relate universal precautions to infection prevention, 6 (7%) nurses and 2 (6%) technicians had knowledge about proper hospital waste segregation, 45

(52.9%) nurses and 15 (42.8%) technicians had knowledge about post-exposure prophylaxis and 3 (4%) nurses and 9 (26%) technicians were formally trained in following universal precautions. Adequate hand washing was practiced among 17 (20%) nurses and none of the technicians. Faulty practice such as recapping of needle was prevalent among 57 (67%) nurses and 29 (83%) technicians while 32 (38%) nurses and 10 (29%) technicians have received hepatitis B vaccine. As knowledge and practice regarding different aspects of universal precautions was not satisfactory, training was warranted urgently in the study population. Also, suggestions were made to develop and implement institutional policies on the universal precautions and ensuring supply of personal protection equipment (Phukan, 2014).

2.5 Factors affecting Compliance to Biosafety Guidelines

A successful laboratory safety program encompasses a continuous process of hazard recognition, risk assessment, and hazard mitigation. The risk for exposures, laboratory-acquired infections, and the unintended release of research or clinical materials to the environment should ultimately be reduced by ensuring the compliance of laboratory workers at all levels. Compliance with standard precautions reduces the risk of exposure to blood and body fluids (Chan, 2002). According to Ochei *et al*., (2000) each biosafety level has guidelines for appropriate containment level which consist of combinations of laboratory practices and techniques, safety equipment and laboratory equipment. Both the employer and the employee share the responsibility for safety in a clinical laboratory. The employer has moral and legal obligations to provide a safe workplace. The employee also should be aware of his role for his own safety and the safety of his co-workers (Lago and Alrami, 2014). Many factors are responsible for non-adherence to the basic principles of these guidelines among health care workers which include laboratory technologists.

A study that was done by Akgur and Dal (2012) in Cyprus to assess factors that led nurses not compliant with Standard Precaution showed that, the barriers to apply the Safety Precaution measures were lack of equipment, negative influences of protective equipment on staff such as skin irritation, overwork of staff, lack of staff, and psychological factors, time consuming application of guidelines, working experiences, and influence on staffs' appearance. In Karachi, Pakistan, majority of the health care workers assessed reported that they were not provided with proper facilities for handling infectious wastes as only 8% of the laboratories had proper waste management plans and biosafety cabinets (Nashim *et al*., 2008). In another study by Abou El-enein and El Mahdy, (2011) in a University hospital in Egypt, interference with the practice of care, absence of role model from colleagues or superiors, and the high work load or lack and inaccessibility of sinks were found to be the factors and barriers that influenced and impeded non - compliance to the Safety Precaution measures. Lack of awareness and knowledge and lack of equipment was staged as the factors in Western Algeria by Beghdadli *et al*., (2008).

It was however shown that perception of senior management and/or employers' support for safety programmers was the most significant factor influencing compliance with infection control and reducing exposure incidents (Omokhodion, 1998; Zaveri and Karia, 2005). Another important measure is adequate professional immunization, as this guarantees anticipated protection against immune-preventable diseases. The differences in knowledge of universal precaution by health care workers may be influenced by their different level of compliance. Gershon *et al*., (1995) and Michalsen *et al*., (2007) observed that better knowledge of universal precautions among HCWs was one of the correlates of good compliance. Knowledge of standard precautions by Health Care Workers may be influenced by their type of training. Compliance on the part of healthcare workers with standard precautions has been recognized as an efficient means to prevent and control health care-associated infections in patients and health workers (Jeong *et al*., 2008; Abdulraheem *et al*., 2012).

Individual and organizational attitudes regarding safety also influence compliance to laboratory biosafety. A study assessing compliance of Medical scientist at Northern Mindanao Medical Center to the Biosafety Standards observed that the Medical Technologists have demonstrated high compliance in almost all biosafety level standards but medium compliance was only observed in Eating, drinking, smoking and applying cosmetics even though they are not permitted in the work area. This shows, that despite their high compliance in all the standards, the laboratory staff cannot help but eat, drink, and apply cosmetics in the area. The study recommended the need for enforcement of

Policies inside the laboratory protect against harm and damage both in the laboratory and the person performing such activities (Lago and Alrami, 2014).

2.7 Conceptual Framework

The PRECEDE framework principles were applied to this study

2.7.1 The Precede Framework

This outlines and describes the antecedent factors that influence behaviours. These factors are: Predisposing factors, Enabling factors and Reinforcing factors.

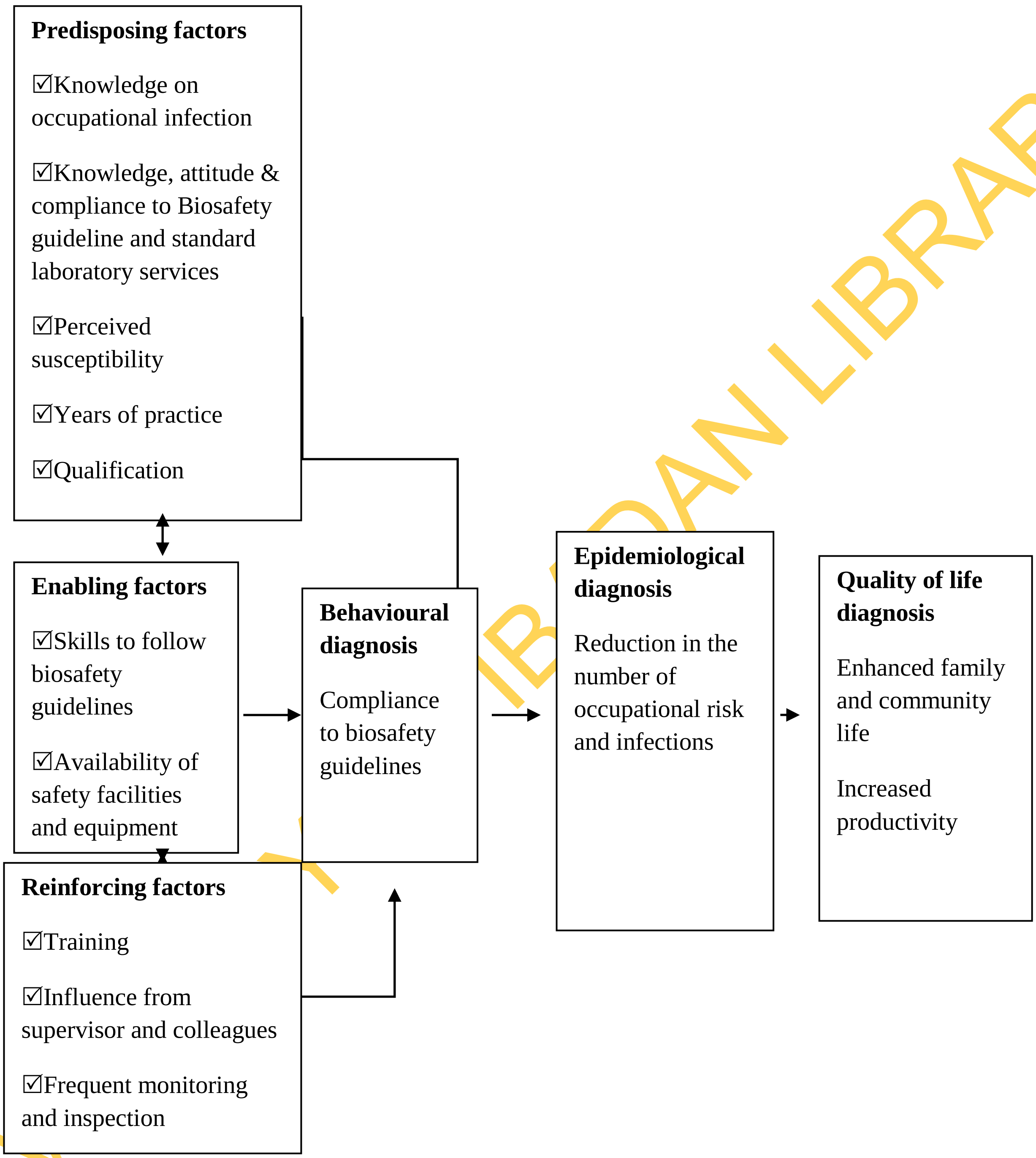
2.7.2 Predisposing factors: These are the antecedents to behaviour that provide rationale for the behaviour. They are knowledge, values, beliefs, attitudes, perceptions, norms, and behavioural intensions. Predisposing factors have the potential to influence the decisions people take about their health and their given health behaviour. They do this by ether encouraging the behaviour or by inhibiting the behaviour from occurring.

2.7.3 Enabling factors: These factors are also antecedents to behaviour because they also influence the realization of motives, aspirations and decisions. These include skills, everyday routines, personal resources, community resources (e.g. availability of health resources, accessibility of health resources), and ability to source for these resources, government policies and access to health related skills.

2.7.4 Reinforcing Factors: This comprises of the feedback or influence of significant orders or people that influence the continuance or discontinuance of a particular behaviour. Examples of these factors include pressure from peers, co-workers, policy makers, patients and other social support group. They are also factors subsequent to behaviour that provide perpetual rewards or incentives for the behaviour and contribute to its persistence or extraction.

The prcede model is applied to this study because it is diagnostic in nature. Adequate knowledge of stages of biosafety level of the laboratory, knowledge and attitude towards biosafety guidelines and perceived susceptibility will serve as the predisposing factors towards the compliance of Biosafety guidelines by laboratory workers. Reinforsing factors may be training which may be seminar or workshops on biosafety guidelines or influence of the supervisors and colleages to practice the guidelines. Availability of safety facilities, equipments and skills to follow biosafety guidelines consistitute the enabling factors.

THE PRECEDE FRAMEWORK



`PRECEDE Model adapted to explain the knowledge, attitude and compliance to biosafety guidelines among medical laboratory scientists in Ibadan metropolis, Oyo State (Green *et al.*, 1980)

CHAPTER THREE

METHODOLOGY

3.0 Study Design

This study adopted a descriptive cross-sectional design. The study sought to assess knowledge, attitude and compliance of biosafety guidelines among medical laboratory scientists in Ibadan metropolis.

3.1 Description of Study Site

The study was carried out in Ibadan, Ibadan is the state capital of old western region and still remain as the state capital of Oyo State. Ibadan is located in the South-western part of Nigeria. It occupies a large area of 3123.30km^2, 15% of which falls within the urban sector. The remaining 85% are in the rural setting. It is the largest city in West Africa and the capital of Oyo State with 11 local government areas. Out of the 11 Local Government Area, 5 are urban while the remaining 6 are rural based. The urban local governments are Ibadan North, Ibadan Northwest, Ibadan Northeast, Ibadan Southeast and Ibadan Southwest while the rural local governments are Akinyele, Lagelu, Egbeda, Onaara, Oluyole and Ido. Ibadan is homogeneous it comprises mainly Yoruba who speaks Yoruba language.

Different categories of health institutions, health care center and diagnostic centers belonging to federal, state, local governments and individuals are found in Ibadan metropolis. The federal and state and some private health care run NHIS (National Health Insurance Scheme). The target populations are scattered throughout the city, working in government and private laboratories mostly in Ibadan north local government and other local governments' areas in Ibadan.

3.2 Study Population

The target population of the study is laboratory scientists of primary, secondary, tertiary and private health care facilities in Ibadan metropolis. The laboratory scientists are professionals who have undergone training in the university or graduates of related sciences such as Microbiology, Chemistry, Biochemistry and Zoology who have also obtained a diploma degree from the Institute of Medical Laboratory Science of Nigeria, the council that regulates the practice and training in medical laboratory science in Nigeria.

3.5 Sample size and sampling procedure

Medical laboratory scientists working in Ibadan metropolis were the targeted respondents for this study. Although there are many health institutions in the Ibadan metropolis, many of them do not have functional laboratories while some of them are yet to be registered with medical laboratory scientists' association bodies. As such, the study made used of registered medical laboratories scientist working, either in public or private sectors in the metropolis. As a result, total sample size available for the study was small. This necessitated the use of total population; involving the enrollment of all available government and private medical laboratory scientists in Ibadan metropolis into the study.

A total of 304 registered members are available in Ibadan. Out of this 304, 30 respondents were used for the pretest in Akinyele Local Government Area, Moniya, Ibadan. This left behind 274 to be used for the study (2 scientists did not consent to the study, 7 were on leave and the remaining 5 were not found). As such, 14 medical laboratory scientists did not take part in this study.

Only 250 respondents were recruited into the study: 250 laboratory scientists consisting of 127 male 123 female were enrolled.

3.6 Inclusion Criteria

Registered laboratory scientists working in a primary, secondary, tertiary and private health care facilities in Ibadan metropolis and were willing to give an informed consent were included in the study.

3.7 Exclusion Criteria

Other health workers that are not laboratory scientists working selected health care facilities for this study and laboratory scientists that were not willing to give an informed consent were excluded in the study.

3.8 Method of Data Collection

The study utilized quantitative method of data collection using self-administered questionnaire. A structured questionnaire consisting of six sections was used.

A questionnaire was developed using adapted biosafety guidelines (see appendix 1) and are used for data collection. The questionnaire was structured and self-administered. The design of the questionnaires was based on research objectives, review of the literature on Biosafety guidelines (see appendix 3), and the guidance of the supervisor. The questionnaires consist of six (6) sections. The first part explores the socio-demographic characteristics of the subjects. The second section explored the knowledge of the scientists. The third part explored the attitude towards the Biosafety guidelines. And the fourth section explored the compliance of the respondents. Fifth sections explored the barriers faced in some facilities and the six sections were suggestions on how to overcome the barriers. The total numbers of questionnaire administered was 250.

The questionnaires were self-administered and collected on the spot. Four research assistants were employed and trained to facilitate proper filling of the questionnaires. The questionnaires were completed in about 30 minute's time. They were checked for completion before it was accepted by the research assistants. The period of data collection lasted four weeks. It started in the first week of September 2015 and ended in the first week of October.

3.9 Data Collection Process

The administration of the questionnaire was done by the researcher with the help of four trained research assistants; two females and two males. The questionnaire was self-administered since the research participants are professionals. The questionnaires were distributed in health facility from 2:00 pm to 4:00pm for four weeks. In every health facility selected for data collection the consent of the participants was sought before the distribution of the questionnaire by explaining the purpose of the research. The questionnaires were retrieved immediately from the respondents after completion and checked for completeness.

3.9 Validity

Relevant literature (biosafety guidelines) and formulated objectives guided the development of the instrument. The instrument was also reviewed by my research supervisor, and colleagues. The supervisor's comments and corrections were used to further enhance the quality of the instrument**.**

Following review and approval by the project supervisor, thirty questionnaires were pretested among 30 medical laboratory scientists: these respondents were recruited from the 2 Division Hospital Adekunle Fajuyi Cantonment Odogbo Ojoo Ibadan representing tertiary health facilities, Moniya General Hospital for secondary health facility, Ajibode primary health care, a private hospital at Ojoo and two diagnostic centers, which is similar to the main study area as regards population, characteristics and socio-demography. The pre-test excluded laboratory workers who are not registered medical laboratory scientists. After the administration of the questionnaires, they were asked about the simplicity of each question, whether they understood the questions or not and suggested the removal of some questions.

The instrument was reversed after the pre-test as some questions were removed and some added. Question number 6 Section A; "what is the name of your facility" was reversed, as some hospitals did not respond to this questions and the commander in military hospital comment that it should be removed for security reasons. More so, the questions number 21 "syringes and other waste can be disposed together" was added to test for knowledge of the respondents on waste segregation. More so, questions 10, 1 on attitudes were rectified, and more questions were added in other to effectively probe the respondents.

These amendments helped ascertained the effectiveness of the instrument in collecting appropriate data relevant to the research objectives.

3.10 Reliability

A measure is said to have a high reliability if it produces consistent results under consistent conditions. Thirty (30) questionnaires were pretested among medical laboratory scientist in tertiary health facility (Military hospital) secondary health facility, (State hospital Moniya), primary health care center (Ajibode) a private hospital and some diagnostic centers in Akinyele Local Government Area to determine its consistency and accuracy.

The outcome of the pre-tested instrument helped in modifying the final questionnaire where some revisions were made to improve the clarity of the questions. Measure of internal consistency was determined using the Cronbach's Alpha coefficient method. For this method of reliability measurement, the result which shows a correlation coefficient greater than 0.5 which is 0.83 said to be reliable as it moves closer to 1.

3.11 Data Management and Analysis

The questionnaires were serially numbered for control and recall purposes. It was checked for completeness and accuracy on daily basis. It was also sorted, edited and coded manually by the investigator with the use of the coding guide. The data was imputed into the computer and the analysis was carried out using SPSS software version 20. Frequency counts were run to detect missing cases while the data undergo cleaning. Descriptive statistics (Chi- square) was used for the analysis.

Descriptive statistics such as frequency counts, percentages, mean and standard deviation was used to analyze the data using the Statistical Package for Social Sciences (SPSS) version 20. Where applicable, the Chi-square test statistics was employed to describe associations between two categorical variables and compare proportions with p-value set at < 0.05 at a confidence interval of 95%.

Knowledge of participants was assessed with a 21 point scale. Scores 0-7 was categorized as poor knowledge, scores $>7 \leq 14$ was categorized as fair knowledge and scores >14 was categorized as good knowledge. Similarly, attitude of respondents was assessed with a 13–point attitudinal scale with scores 0-6 categorized as poor attitude and scores > 6 is categorized as negative attitude and as positive attitude. A 42-point compliance scale was used to assess the compliance of the respondents to the guidelines. Compliance scores 0 – 20 and > 20 were scored low and high level of compliance respectively.

3.12 Ethical Approval

Ethical approval for the study was obtained from the Oyo State Ministry of Health Ethical Review Committee. Permission was taken from the managements of all the health facilities being used. Verbal informed consent was obtained from respondents before administering questionnaires. Ethical issues like confidentiality, opportunity to decline interview at any stage and non-exposure to risk was also discussed with each respondents. Only respondents who are able to give written informed consent were recruited into the study. The written consent obtained did not require the names of the participants or any other identifiers but require their signatures and date. They were informed that participation is voluntary and that data collected would be used mainly for research purposes. Anonymity and confidentiality of responses was ensured.

Confidentiality of data: In order to assure respondents of confidentiality of the information that was supplied, names of respondents were not required, only identification number was assigned to the questionnaires by the investigator for proper recording.

Beneficence to participants: The outcome of the research will be of potential use to the hospital in that it will serve as a guide to help improve patients' care.

Non-maleficence to participants: The research did not require collection of invasive materials. However, there were some of the respondents will find some of the questions uncomfortable to answer.

Voluntariness: Participation in the study was strictly voluntary. As a result, participants were free to withdraw from the study at any time.

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Non-maleficence to participants: The research did not require collection of invasive materials. However, there were some of the respondents will find some of the questions uncomfortable to answer.

Voluntariness: Participation in the study was strictly voluntary. As a result, participants were free to withdraw from the study at any time.

3.13 Limitation and suggestion for future studies.

Due to the small sample size of this study, generalization of results to all laboratory scientists should be done with caution. Future research should include a larger sample size with participants randomly drawn from several laboratories, thereby providing a more representative sample of the population and greater generalizability of the study findings.

CHAPTER FOUR

RESULTS

4.1 Socio-demographic Characteristics

Most of the respondent (90.4%) fell between 23 to 5 years age group while others are 50 years and above, the mean age being 40.0 ± 8.1. Half of the respondents (50.2%) were male and a little over average (58.0%) were married. Majority of the respondents (79.2%) were Yoruba followed by the 16.0% that were Igbo. The prominent religion is Christianity (67.7%) followed by Islam (29.2%). Majority of the respondents (52.4%) spent 8hrs at work while some (18.8%), (12.4%), (10.8%). Five out of every ten scientists spend eight hours at work. Many of them (62.8%) have attended biosafety training before (Table 4.1).

Table 4.1: Socio-demographic characteristics of the respondents (N=250)

Socio-demographic variable	Frequency	Percentage
Age (in years)		
23-50 years	226	90.4
51 and above	24	9.6
Sex		
Male	127	50.2
Female	123	49.2
Marital status		
Single	96	38.4
Married	145	58.0
Others	9	3.6
Ethnicity		
Yoruba	198	79.2
Igbo	40	16.0
Hausa	11	4.4
Others	1	0.4
Religion		
Christianity	169	67.7
Islam	73	29.2
Traditional	8	3.2
Hours spent at work		
6 hours and below	27	10.8
7hrs	47	18.8
8hrs	131	52.4
9hrs	31	12.4
10hrs and above	14	5.6
Ever Attended biosafety training		
Yes	157	62.8
No	69	27.6
No response	24	9.6

4.2 Knowledge on Laboratory Biosafety guidelines

Figure 4.1 shows that majorityof the respondents (80.4%) had good knowledge, 9.6% had fair knowledge, while 10.0% had poor knowledge oflaboratory biosafety guidelines. The mean knowledge score was 16.1± 4.7.

Almost all the respondents (92.0%) correctly stated that biosafety guidelines are the planning, improvement, and implementation of interventions designed to maintain and improve the health of a group of individuals. Similarly, almost all of them (97.6%) correctly identified laboratory guidelines as guidelines to prevent occupation hazards among laboratory workers. Majority (76.8%) of the respondent reported risk assessment as a component of laboratory biosafety guidelines while a high percentage of them (84.4%) said that disposal of wastes is not in the component of laboratory biosafety guidelines. Most (78.8%)disagreed that preventive measure against HBV and HCV is a component while 78.8% of the respondents stated that it is applicable only when handling HIV positive and 87.6% reported that knowledge on biosafety applies to all samples irrespective of diagnosis (as shown in table 4.2a).

Majority (80.4%) of respondents said laboratory settings must have eye washing station. Majority(90.0%) of the respondents said fire extinguishers are compulsory in the laboratory. Also, 66.4% said that creation of aerosol by centrifuge does not pose any risk to laboratory workers including technicians, while almost all of the respondents (94.0%) said wearing personal protective gadget is not a waste of time especially when there is a lot of work. Majority (87.6%) of the respondent were aware that wearing of leather shoe is not compulsory (. table 4.2b).

Almost all of them (91.6%) said that drinking and eating in laboratory are not permissible, Most of the respondents (80.4%) said processing of sputum in congested laboratory is permissible while most of them (86.4%) said the hand of laboratory scientist should be washed not only after collecting sample from the patients. More so, 87.2% were aware that it is necessary to immunize against HBV. A significant percentage (68.8%) of the respondents reported that recapping of needle is not dangerous to the phlebotomist. Almost all the respondents (90.0%) said all reagent bottles/container should be clearly labeled. Only a little above half of the respondents (52.8%) said no form of carpeting is acceptable in the laboratory. Almost all the respondents (84.8%) agreed that laboratory area with the radioactive materials is to be labeled with instructions. Additionally, 58.0% of the respondent stated that syringe with other laboratory waste can be disposed together. This is shown in table 4.2c.

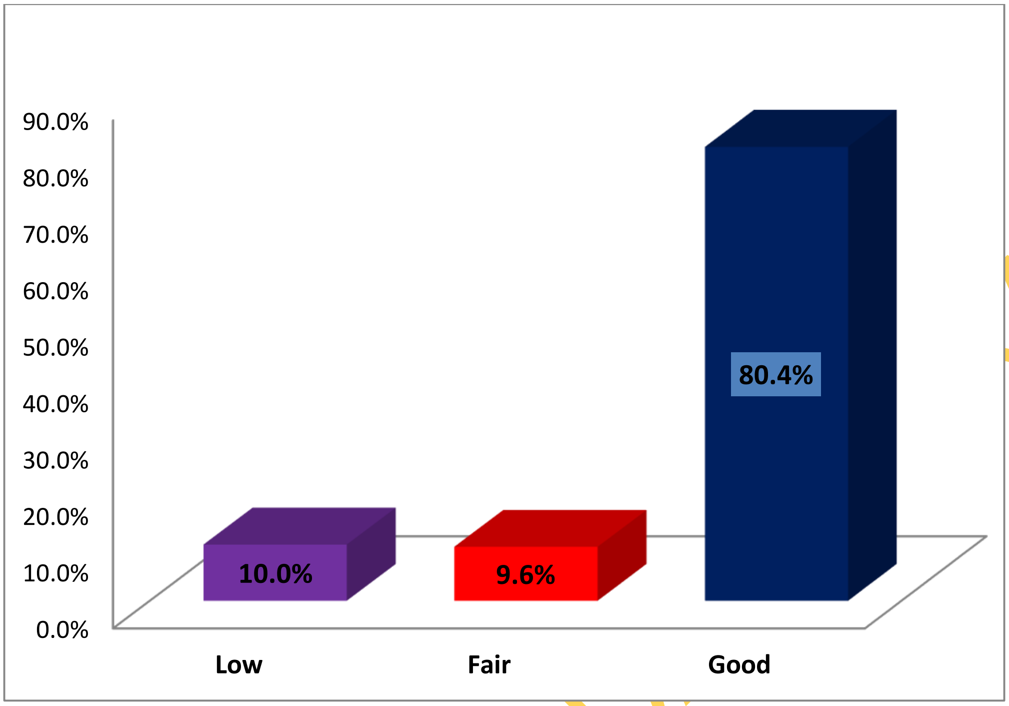

Figure 4.1: Knowledge on Laboratory Biosafety guidelines

Table 4.2a: Knowledge on meaning and component of biosafety

Statements	Response			Total
	TRUE	FALSE	I don't know	
Are planning, improvement and implementation to maintain health of individual	230(92%)	10(4%)	10(4%)	250(100%)
Prevent occupation hazards	244(97.6%)	3(1.2%)	3(1.2%)	250(100%)
Risk assessment is a component	192(76.8%)	22(8.8%)	36(14.4%)	250(100%)
Disposal of waste is not a component	27(10.8%)	211(84.4%)	12(4.8%)	250(100%)
Preventive measure against HBVand HCV is not a component	24(9.6%)	197(78.8%)	20(8%)	250(100%)
Applicable only when handling HIV positive	24(9.6%)	197(78.8%)	29(11.6%)	250(100%)
Applies to all samples irrespective of diagnosis	219(87.6%)	20(8.0%)	11(4.4%)	250(100%)

Table 4.2b: Knowledge on safety equipment and equipment handling

Statements	Response			
	TRUE	**FALSE**	**I don't know**	**Total**
Must have eye washing station	201(80.4%)	26(10.4%)	23(9.2%)	250(100%)
Fire extinguisher is not compulsory	19(7.6%)	225(90%)	6(2.4%)	250(100%)
Creation of aerosol by centrifuge does not pose any risk	24(9.6%)	166(66.4%)	60(24%)	250(100%)
Wearing personal protective equipment is waste of time	8(3.2%)	235(94%)	7(2.8%)	250(100%)
Wearing of leather shoe is not compulsory	11(4.4%)	219(87.6%)	20(8%)	250(100%)

Table 4.2c: Knowledge on waste handling and immunization and other precautions

Statements	Response			Total
	TRUE	FALSE	I don't know	
Drinking and eating in laboratory is permissible	10(4%)	229(91.6%)	11(4.4%)	250(100%)
Processing of sputum in congested lab is permissible	25(10%)	201(80.4%)	24(9.6%)	250(100%)
Hand wash after collecting sample only	22(8.8%)	216(86.4%)	12(4.8%)	250(100%)
Necessary to immunize against HBV	218(87.2%)	17(6.8%)	15(6%)	250(100%)
Recapping of needle is dangerous	172(68.8%)	66(26.4%)	12(4.8%)	250(100%)
Labelling of bottles	225(90%)	19(7.6%)	6(2.4%)	250(100%)
Carpeting not acceptable	132(52.8%)	51(20.4%)	67(26.8%)	250(100%)
Labelling of radioactive materials	212(84.8%)	24(9.6%)	14(5.6%)	250(100%)
Syringe with other waste can be disposed together	82(32.8%)	145(58.0%)	23(9.2%)	250(100%)

4.3: Association between demographic characteristics and knowledge about Biosafety guidelines

Analysis of the association between the demographic characteristics of the respondents and knowledge of biosafety guideline displayed in the table 4.2.2shows that the age of the respondents is significantly associated with their knowledge of biosafety guideline(X^2 = 26.505, df = 2, p = .000). The knowledge of biosafety guideline decreases with increase in age. Also, gender of the respondents is significantly associated with their knowledge of biosafety guideline(X^2 = 10.803, df = 2, p = .004). Female scientists have good knowledge about biosafety guideline. The marital status of the respondents is significantly associated with their knowledge of biosafety guideline (F = 41.377, p = .000). The married scientists have more knowledge about biosafety guideline than those unmarried.

Table 4.3: Association between demographic variables and knowledge about Biosafety Guidelines

		Knowledge					
Demographic variables		**Low**	**Fair**	**Good**	X^2	***df***	***p***
		N(%)	**N(%)**	**N(%)**			
Age	**23-50 years**	19 (7.6)	16(6.4)	191(76.4)	26.505	2	0.000
	51 and above	6(2.4)	8(3.2)	10(4.0)			
Gender	**Male**	19 (7.6)	16(6.4)	92(36.8)	10.803	2	0.004
	Female	6(2.4)	8(3.2)	109(43.6)			
		Low	**Fair**	**Good**	**F-Test**		***p***
Marital Status	**Single**	1(0.4%)	0(0.0)	95(38.0)	41.377		0.000
	Married	24(9.6)	24(9.6)	106(42.4)			

4.4: Respondents Attitude towards Biosafety Guidelines in Laboratory

Majority of the respondents (88.0%) agreed that Hepatitis B is an important occupation hazard among laboratory workers but only a little above half of the respondents (58.0%) perceived themselves to be at risk of contracting infectious disease such as HIV. More than half of the total respondents (58.0%) had poor risk assessment of infectious disease such as HIV. Most of the respondents (83.6%) agreed that laboratory scientists cannot contract infectious disease such as hepatitis and HIV as long as they strictly follow biosafety guidelines.

Almost all of them (88.4%) reported that it is wrong to eat in laboratory only if it is in clean area. Majority (89.2%) said that Biosafety guidelines must be followed at all times by all laboratory personnel. About a quarter (25.2%) of the respondents said biosafety guidelines is too cumbersome while only some of them (41.2%) stated that it is not cumbersome. Most of the respondents (84.0%) said that all scientists should not involve in any activities without wearing personal protective equipment. Just a little above half of respondents (51.6%) disagreed that reuse of gloves save additional cost; therefore it is justifiable although some of the respondents (37.6%) admitted that they were undecided. Majority of the respondents (79.2%) disagreed that wearing of leather shoes is inconvenient; therefore it should not be made compulsory. This is reflected in table 4.3a.

Most of the respondent disagreed with the fact that hanging laboratory apron inside car is good and that it does portray dignity and high level of identity. Majority of the respondents (67.6%) disagreed that prayers after needle prick cures more than post exposure prophylaxis while a little above half (57.6%) disagreed that taking hepatitis B immunization is not necessary if other biosafety guidelines are strictly followed although about a quarter (26.8%) agreed (as shown in table 4.3b). In summary, the mean attitudinal score was 8.4 ± 3.5 with majority of the respondents (79.0%) having positive attitude, while 21.0% had negative attitude towards laboratory biosafety guidelines (Figure 4.2).

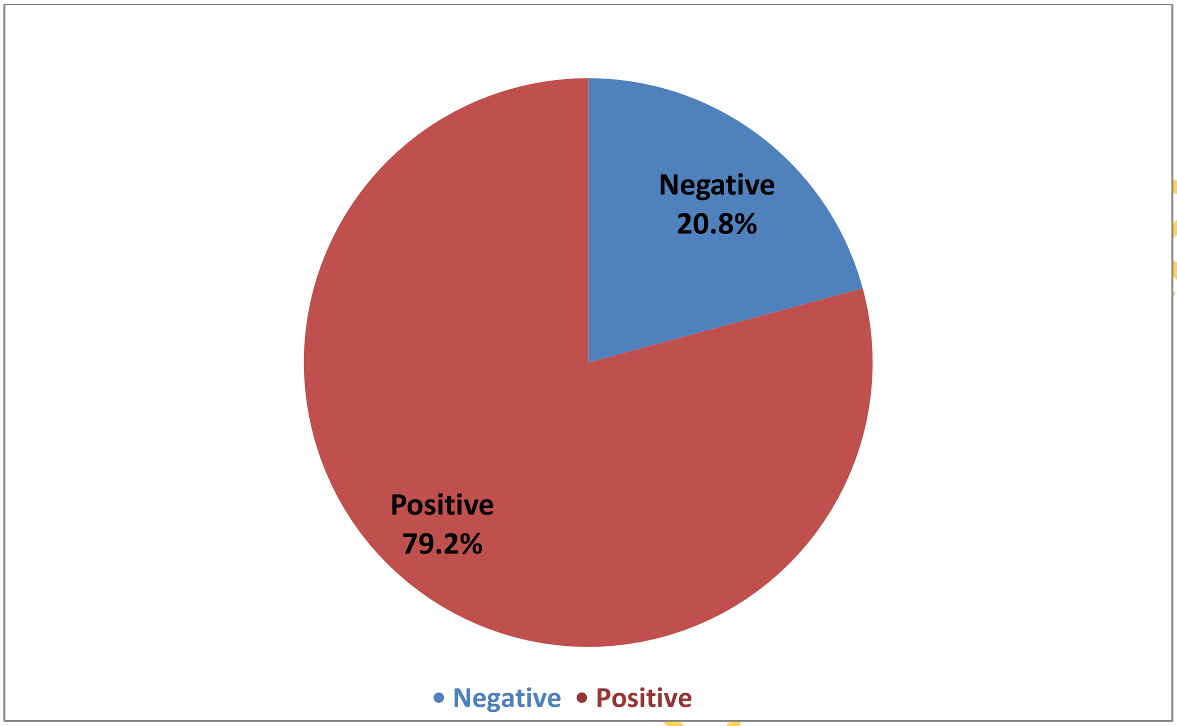

Figure 4.2: Attitude towards Laboratory Biosafety guidelines

Table 4.4a: Respondents' Attitude towards laboratory biosafety guidelines

Statements	Response			
	Agree	**Disagree**	**Undecided**	**Total**
Hepatitis B are important occupation hazard among laboratory workers	220(88.0%)	8(3.2%)	22(8.8%)	250(100%)
I am not at risk of contracting infectious disease such as HIV	145(58.0%)	57(22.8%)	48(19.2%)	250(100%)
Laboratory scientists cannot contract infectious disease such as hepatitis and HIV as long as they strictly follow biosafety guidelines	209(83.6%)	22(8.8%)	19(7.6%)	250(100%)
There is nothing wrong in eating in laboratory only if it is in clean area	21(8.4%)	221(88.4%)	8(3.2%)	250(100%)
Biosafety guidelines must be followed at all times by all laboratory personnel	223(89.2%)	22(8.8%)	5(2.0%)	250(100%)
Biosafety guidelines is too cumbersome	63(25.2%)	103(41.2%)	84(33.6%)	250(100%)
All scientist should not involve in any activities without wearing personal protective equipment	210(84.0%)	23(9.2%)	17(6.8%)	250(100%)
Reuse of gloves save additional cost, therefore it is justifiable	27(10.8%)	129(51.6%)	94(37.6%)	250(100%)
Wearing of leather shoes is inconvenient, therefore it should not be made compulsory	17(6.8%)	198(79.2%)	35(14.0%)	250(100%)

Table 4.4b: Respondents attitude towards laboratory biosafety guidelines

Statements	Response			
	Agree	**Disagree**	**Undecided**	**Total**
Hanging laboratory apron inside car portray my dignity and high level of identity, therefore I need to hang it	21(8.4%)	198(79.2%)	31(12.4%)	250(100%)
Hanging apron in the car does not pose any kind of risk	20(8.0%)	202(80.8%)	28(11.2%)	250(100%)
Prayers after needle prick cures more than post exposure prophylaxis	7(2.8%)	168(67.6%)	74(29.6%)	250(100%)
Taking hepatitis B immunization is not necessary if other biosafety guidelines are strictly followed	67(26.8%)	144(57.6%)	39(15.6%)	250(100%)

4.5 Compliance to Biosafety Guidelines

About half of the respondents (50.8%) said they never work in the laboratory without wearing apron (lab coat) although some of them (28.4%) admitted they work in the laboratory without wearing aprons once in a while, very few (6.8%) said they always work in the laboratory without wearing apron or lab coat.

About one-third of the respondents (30.8%) stated they sometimes wear open slippers to laboratory. Less than half of the respondents (44.4%) said they never perform any laboratory procedure on blood or body fluid without wearing glove although few of them while 32.8% said they do it once in a while. 13.2% always perform any laboratory procedure on blood or body fluid without wearing glove. Most of the respondents (86.5%) said they never pipette with their mouth. Majority of the respondents (63.6%) said they never reuse gloves, never eat or drink in the laboratory (75.6%), never store food or drink in laboratory refrigerator (83.6%) and never hang apron (lab coat) in their cars after work (Table 4.4a).

A little above half of the respondents (63.6%) stated that they never reuse gloves between tasks and procedures on the same patient after contact with material that may contain a high concentration of microorganisms, some of them however (21.6%) said they change gloves between tasks and procedures just once in a while. Less than half of the respondents (40.8%) reported that they never eat or drink in the laboratory, 34.8% reported doing that once in a while, and 23.2% sometimes do it. Majority 83.6% of the respondents never store food or drink in the laboratory refrigerator. Furthermore, 68.8% of the respondents reported that they never hang apron (lab coat) in their car after work while 21.6% sometimes do that.

Almost half of the respondents (45.2%) forget wearing personal protective gadget especially when there is a lot of work although some of them (39.2%) admitted they once in a while forget wearing personal protective gadget especially when there is a lot of work while 15.6% said they sometimes forget to use personal protective gadgets. Most of the respondents (88.4%) have never experienced spillage of specimen on their skin or face during laboratory procedures, while (11.6%) reported otherwise.

Based on the respondents response to spillage of specimen, 30.4% of the respondent washed that affected part with soap, 17.2% used disinfectant and cotton wool, 15.2% clean immediately with swab, 8.4% washed with running water, 4% applied treatment and only 0.4% go to the bathroom to bath. Most of the respondents (87.2%) experienced needle stick injury before. Of those that have experienced needle stick before, some of them (11.6%) never experienced it. (1.2%) gave no response. 34.4% were exposed to post prophylaxis while 27.6% were not exposed to it. Only few of the respondents (31.2%) were immunized against Hepatitis B, of which only 50.05 of them completed the dose (as shown in table 4.4b).

As shown in Fig. 4.3, majority of the respondents (91.8%) had low level of compliance, while 8.8% had high level of compliance to laboratory Biosafety guidelines.

Table 4.5a: Compliance to laboratory Biosafety guidelines

Variable	Frequency	Percentage
Work in the laboratory without wearing apron (lab coat)?		
Always	17	6.8
Sometimes	35	14.0
Once in a while	71	28.4
Never	127	50.8
Wear open slippers to laboratory?		
Always	3	1.2
Sometimes	77	30.8
Once in a while	77	30.8
Never	9	3.6
Perform any laboratory procedure on blood or body fluid without wearing glove?		
Always	1	.4
Sometimes	56	22.4
Once in a while	82	32.8
Never	111	44.4
Pipette with your mouth?		
Always	10	4.0
Sometimes	9	3.6
Once in a while	15	6.0
Never	216	86.5
Reuse gloves?		
Always	4	1.6
Sometimes	33	13.2
Once in a while	54	21.6
Never	159	63.6
Eat or drink in the laboratory?		
Always	3	1.2
Sometimes	58	23.2
Once in a while	87	34.8
Never	102	40.8
Store food or drink in laboratory refrigerator?		
Always	1	0.4
Sometimes	11	4.4
Once in a while	29	11.6
Never	209	83.6
Hang apron (lab coat) in my car after work?		
Always	12	4.8
Sometimes	12	4.8
Once in a while	54	21.6
Never	172	68.8

Table 4.5b: Compliance to laboratory Biosafety guidelines

Variable	Frequency	Percentage
Change gloves between tasks and procedures on the same patient after contact with material that may contain a high concentration of microorganisms?		
Always	130	52.0
Sometimes	39	15.6
Once in a while	47	18.8
Never	34	13.6
Forget wearing personal protective gadget especially when there is a lot of work		
Always	0	0
Sometimes	39	15.6
Once in a while	98	39.2
Never	113	45.2
Have you ever experience spillage of specimen on your skin or face during laboratory procedures?		
Yes	221	88.4
No	29	11.6
If yes to question 'what did you do?(N=29)		
Washed with running water	21	8.4
Washed affected part with soap	76	30.4
Applied treatment	10	4.0
Clean immediately with swab	38	15.2
Use disinfectant and cotton wool	43	17.2
Washed with soap and disinfectant	32	12.8
Go to the bathroom to bath	1	.4
Experience needle stick injury before?		
Yes	218	87.2
No	29	11.6
No response	3	1.2
Have you use post exposure prophylaxis?		
Yes	86	34.4
No	69	27.6
Are you immunized against Hepatitis B?		
Yes	78	31.2
No	172	68.8
If yes, did you complete the dose? (N=78)		
Yes	49	19.6
No	29	11.6

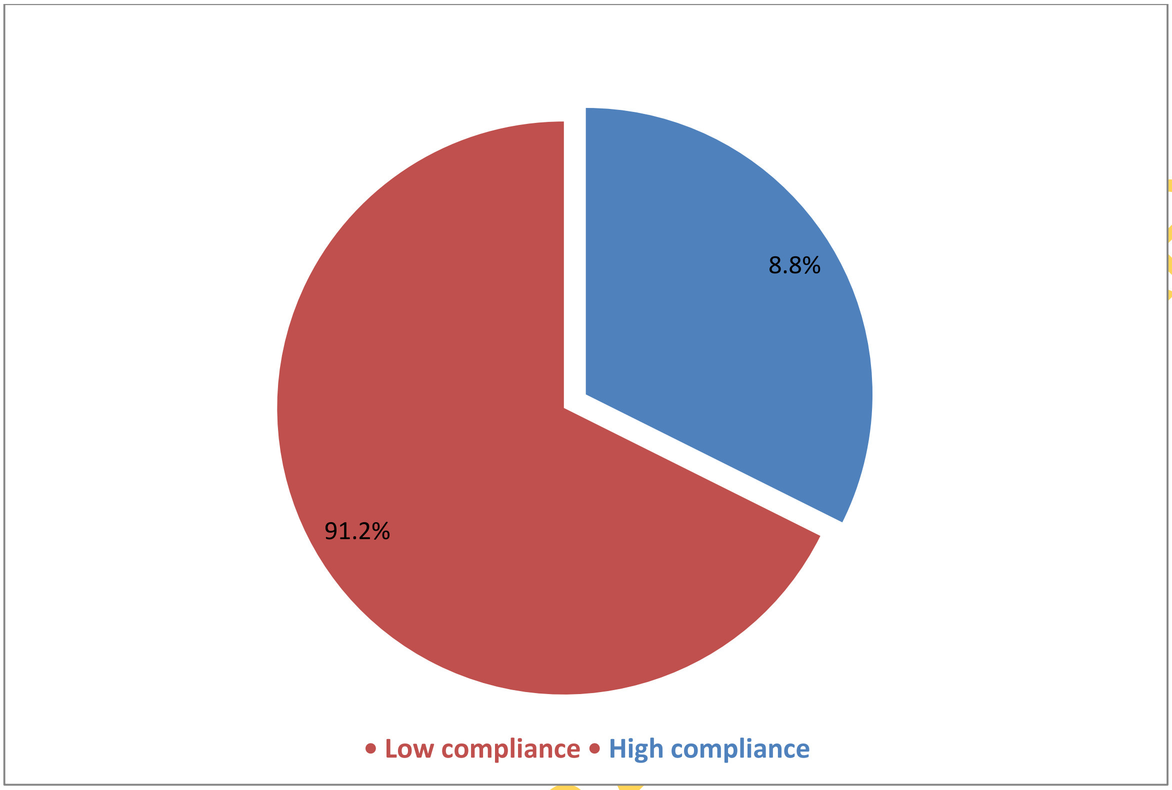

Figure 4.3: Compliance to Laboratory Biosafety guidelines

4.6 Issues Affecting Respondents' Laboratory

Table 4.5 shows that the following are issues affecting the laboratories where respondents work; inadequate supply of water (74.0%), inadequate supply of gloves (68.0%), supply of substandard personal protective equipment such as nose mask (67.6%), lack of adequate supervision (67.6%), lack of washing hand station (90.8%). Lack of first aid box (83.2%), lack of fire extinguisher (88.0%), Non-challant attitude of the staff (28.0%), working in a congested environment (34%), inadequate supply of disinfectants (6.8%), supply of substandard laboratory disinfectant (13.6%), lack of occurrence register in the laboratory to inform the younger scientist about past experience (11.2%) and no lab coat (19.2%).

Some of the respondents (6.4%) suggested adequate supply of water in order to improve the challenges facing their laboratory. Other suggestions offered were ensuring building of well-equipped laboratory (4.5%), laboratory should be mandated to have first aid box (4.8%) and improvement of SOP.

Table 4.6: Issues Affecting Respondents' Laboratory

Variable	Frequency	Percentage
Inadequate supply of water		
Yes	65	26.0
No	185	74.0
Inadequate supply of gloves		
Yes	80	32.0
No	170	68.0
Supply of substandard personal protective equipment such as nose mask		
Yes	81	32.4
No	169	67.6
Lack of adequate supervision		
Yes	44	17.6
No	206	82.4
Lack of washing hand station		
Yes	23	9.2
No	227	90.8
lack of first aid box		
Yes	42	16.8
No	208	83.2
Lack of fire extinguisher		
Yes	30	12.0
No	220	88.0
Non-challant attitude of the staff		
Yes	70	28.0
No	180	72.0
Working in a congested environment		
Yes	85	34.0
No	165	66.0
Inadequate supply of disinfectants		
Yes	77	6.8
No	233	93.2
Supply of substandard laboratory disinfectant		
Yes	34	13.6
No	216	86.4
Lack of occurrence register in the laboratory to inform the younger scientist about past experience		
Yes	28	11.2
No	222	88.8
No lab coat (apron)?		
Yes	48	19.2
No	202	80.8

4.7: Test of Hypotheses

Table 4.7shows that the knowledge of the scientists of laboratory biosafety guidelines is significantly associated with their attitude ($F = 174.462$, $p = .001$). Therefore, we reject the null hypothesis which states that there is no significant association between the knowledge of the respondents and the attitude of the respondents towards laboratory biosafety guidelines.

Table 4.7: Association between knowledge and attitude towards laboratory biosafety guidelines

		Knowledge				
		Poor N(%)	**Fair N(%)**	**Good N(%)**	**F Test**	***p***
	Negative	39 (75.0%)	13(25.0%)	0(0.0%)	174.462	0.000
Attitude	**Positive**	0(0.0%)	7(5.2%)	127(94.8%)		

Fisher's exact was used.

Table 4.8 shows that although high level of compliance to laboratory biosafety guidelines of the respondents decreases with age, this was not statistically significant(X^2 = 2.916, df = 1, p = 0.088). Therefore, we accept the null hypothesis which states that there is no significant association between the age of the respondents and their compliance to laboratory biosafety guidelines.

However, there is significant association between the gender of the respondents and their compliance to laboratory biosafety guidelines(X^2 = 2.011, df = 1, p = 0.156). Therefore, we reject the null hypothesis which states that there is no significant association between the gender of the respondents and their compliance to laboratory biosafety guidelines.

Table 4.8: Association between Level of Compliance to Laboratory Biosafety Guidelines and the Age and Gender of the Respondents

		Compliance				
		Low N(%)	**High N(%)**	X^2	***Df***	***p***
	23-50 years	116 (28.4)	7(5.7%)	2.916	1	0.088
Age	**51 and above**	112(88.1%)	15(11.8%)			
	Male	119(93.7%)	8(6.3%)	2.011	1	0. 156
Gender	**Female**	109(88.6%)	14(11.4%)			

Table 4.9 showed that there is significant association between the knowledge of the respondents and their compliance to laboratory Biosafety guidelines (F = 72.57, p = 0. 000). Therefore, we reject the null hypothesis which states that there is no significant association between the gender of the respondents and their compliance to laboratory Biosafety guidelines.

Table 4.9: Association between Level of Compliance to Laboratory Biosafety Guidelines and the knowledge of the Respondents

		Low N(%)	High N(%)	X^2	Df	P-Value
KNOWLEGDE	Low	38(10.0%)	1(0.0%)	3.271	2 0.	170
	Fair	14(5.6%)	6(4.0%)			
	Good	112(16.8%)	15(63.6%)			

Fisher's exact was used.

CHAPTER FIVE

5.0 DISCUSSION, CONCLUTION AND RECORMENDATION

This study explored the knowledge, attitude and compliance to laboratory Biosafety guidelines among medical laboratory scientist in Ibadan municipal. Implication of the findings of this study to health promotion and education was also discussed. Recommendations were made at the end of the report.

Biosafety is a concept which promotes safe laboratory practices, procedures and proper use of containment equipment and facilities by laboratory workers. The prevention of occupational hazards in laboratories requires a thorough knowledge of the risks and practical measures to be taken (Ogunbodede, 1996; Wader, Kumar and Mutalik, 2013).

5.1 Socio- demographic Characteristics

Most respondent fell between 23 to 50 years age group this could be because this age range is core of the workforce in Nigeria which is similar to the study of Mutale *et al.*, (2013) among health workers in Zambia. Half of the respondents were male similar to a study carried out among laboratory scientist in Oyo state by Oladepo & Ogunleye, (2006). Non similar to the study carried out among medical laboratory scientist in Benin City where the male is only one third of the respondents Oladeinde, *et al.*, (2014) the fact that almost all respondents are married is not unexpected considering the age distribution of the respondents. Ibadan, a major city in the south west which is the location of the study also explains why almost are Yorubas.

The study shows that six out of every ten laboratory scientists had attended biosafety training before this could be as a result of the courses medical laboratory scientists are exposed to both internal and during their training at tertiary level. Similar studies conducted in Benin City, Nigeria among medical laboratory scientist and among clinical laboratory educator in Saudi Arabia also revealed that about six out of every ten medical laboratory scientists have attended in-service training programme (Oladeinde *et al.*, (2015) where only a quarter of the laboratory technicians who participated in the study had attended a laboratory biosafety training before.

5.2 Knowledge of Laboratory Biosafety Guidelines

Findings from this study shows that majority of the respondents had good knowledge of laboratory biosafety guidelines. This is probably because many of the laboratory scientists have had the opportunity to attend training on Biosafety similar to the findings of Wader, Kumar and Mutalik, (2013) where all the laboratory technicians from the Microbiology department had good knowledge of biosafety precaution. However, this is in variation to the findings of Adulraheem *et al*., (2012) where only 50% of laboratory staff in the North-Eastern area of Nigeria had no knowledge of laboratory biosafety guidelines. From this study majority of the respondents reported that recapping of needle is dangerous this is in line with the findings of Ogunleye and oladepo (2006).

The study shows that the age of the respondents is not significantly associated with their knowledge of Biosafety guidelines. This could be attributed to the level of the exposure to training that exists among medical laboratory scientist. It is in line with the findings in the study conducted by Yonatan and Kelemu, (2013) among medical and health sciences students where knowledge of transmission and prevention of hepatitis B was not significantly associated with their age.

Female scientist have good knowledge about the biosafety guidelines, this might be due to the fact that women are more willing to learn than men. This relate to the study conducted by Yonatan and Kelemu, (2013) among medical and health science students in Ethiopian university where knowledge of transmission and prevention of hepatitis B was significantly associated with gender of the students.

In addition the married status of the scientist is significantly associated with their knowledge about Biosafety guideline. The married respondents have more knowledge more than those unmarried. This might be the case of the study because more than half of the respondents are married therefore the result was significantly skewed. This is dissimilar to the study conducted by Yonatan and Kelemu (2013) among medical and health science students in Ethiopian university where knowledge of transmission of hepatitis B. was not significantly associated with the marital status of the students.

5.3 Attitude towards Laboratory Biosafety Guidelines

More than half agreed that taking hepatitis B immunization is not necessary if other biosafety guidelines are strictly followed. This may be so because of the belief and the perception of medical laboratory scientists in respect to the susceptibility to infections. This is similar with the report of Wader, Kumar and Mutalik, (2013) where immunization prevalence among the laboratory technicians for HBV was high due to their positive perception. Izegbu, Amole and Ajayi, (2006) also reported that most of the laboratory workers in the two College of Medicine and their teaching hospitals in Lagos state are not immunized against hepatitis B virus (HBV). From this findings 25% of laboratory scientist indicated that laboratory biosafety guidelines is too cumbersome while 33.6% was indecisive.

5.4 Compliance to Biosafety Guideline

The findings from this study showed that most of the respondents never reuse gloves this may be the result of the good knowledge of laboratory scientist about Biosafety guidelines. This is similar to the findings of Wander, Kumar and Mutalik, (2013) among laboratory technicians where all the participants in the study used disposable latex rubber gloves and did not reuse. This may not be unconnected with the awareness of the emerging new infections which can be contracted even through poor laboratory practices. (Oladeinde *et al.*, 2014). Another study by Izegbu, Amole and Ajayi, (2006) in Lagos state showed that respondents wear gloves during laboratory practices but majority wear a single pair.

Three quarter of the respondents said they did not eat or drink in the laboratory this result is higher than the result of the similar study carried out by Omokhodion, (1998) in Ibadan which revealed that six out ten of total respondents eat and drink in the laboratory. This may be so because of the high level of knowledge of the Biosafety guidelines. However, the finding of Barthi and Lala (2012) was dissimilar with this result where less than half of the respondents do not eat or drink in the laboratory.

Majority of the scientist do not store food or drink in the refrigerator this may be attributed to the good knowledge and trainings attended on Biosafety guidelines by the respondents. This is in line with the result of the findings of Shekhar *et al.*, (2015) where less than average of the respondents store food and water in the refrigerator daily. Despite, the high knowledge of laboratory scientist on Biosafety guidelines some still eat, drink, smoke, apply cosmetics and store foods and drinks in the refrigerator in the laboratory. This is similar to the study assessing compliance of medical laboratory scientists at Northern Mindanao Medical center to the Biosafety standard where the respondents demonstrated medium compliance in eating drinking smoking and applying cosmetics in the laboratory. This shows that despite their knowledge, the laboratory staff cannot help but eat, drink, smoke and apply cosmetics in the laboratory. (Lago and Alrami, 2014).

Most of the respondents had experienced needle stick injury before. This may not be unconnected with the exposure of medical laboratory scientists to the equipments such as needles which they widely use to work, This is connected to the nature of their work of laboratory scientist especially the phlebotomist. This is similar to the result from the study carried out by Shekhar *et al.*, (2015) where almost seven out of every ten had experience injury while working and this happed occasionally. However, this is in the variance with the experience of laboratory technicians in a study conducted by Barthi and Lala (2012) in the civil hospital, Ahamedabad, Gujaratw where only one out of every ten of the total respondents had ever experienced an exposure to infectious materials.

5.5.0 Implication of the Study Findings for Health Promotion and Education

Implication for Health Promotion and Education

Findings from this study have health promotion and education implications and suggest the need for interventions directed at tackling the problem. Health promotion has been defined as it is in the Ottawa Charter: "the process of enabling people to increase control over their health and its determinants, and thereby improve their health" (World Health Organization, 1986). Health promotion has also been known to use most of the strategies of health education in solving problems. The key findings from this study show that medical laboratory scientists have good knowledge about biosafety guidelines, they also have good attitude towards biosafety guidelines. However their level of compliance is low. To solve this issue, health promotion and education strategies such as training and advocacy could be used as explained below.

5.5.1 Training

Training as a strategy could be used to sustain the gains in respect to the good knowledge of the respondents on risk associated to needle stick injury, update of the occurrence register and update on numbers of health care workers that are positive to HIV, HBV and HCV these crucial issue and it can also be used to increase the level of compliance of respondents. Medical Laboratory Scientists Association officials at the state level could be trained on the importance of the biosafety guidelines and the health implications of non-adherence to the stated policies. The idea for this training could be initiated by the Medical Laboratory Scientists themselves, the Ministry of Health both at state and federal level or non-governmental organizations. These officials could be trained by experts from the Federal Ministry of Health or the State Ministry of Health. Other experts from private organizations could also be of use in this regard. As with most standard training programmes, a training curriculum could be designed to facilitate the training. The content of the curriculum will include training objectives, training contents, training methods, training materials and evaluation.

The training could be in form of seminars, workshops or conference. Methods used could include teaching, discussion and explanation. The materials used could include the resource persons, lecture notes, learning manuals, pictorials etc. the mode of evaluation could be feedback, comments, questions and answer as well as pre and post-test. The association officials that have been trained can then conduct a step-down training for their members. This training could take place on a particular association meeting day. Using the similar methods and materials as explained before, it will go a long way in boosting the level of compliance of biosafety guidelines among medical laboratory scientists in Oyo state.

5.5.2 Advocacy

The problem of low level of compliance of biosafety guidelines among medical laboratory scientist could also be solved by adopting the strategy of advocacy. Advocacy involves actions designed to generate policies and gain support for a particular health goal. This can be used to facilitate the construction of standard laboratories. Based on this findings majority of the respondent know that recapping of needle is dangerous. Policy on recapping of needles should be reversed. Advocacy could be achieved by using methods such as media advocacy and lobbying by interest groups (e.g. non-governmental organizations and civil groups). This will be important in formulating new policies and enforcing existing policies as well. In this case, a policy that will be binding on all medical scientists which will also help increase their level of compliance to biosafety guidelines is needed. This could be done through creation of a task force to monitor laboratory scientists as well as establishing punitive measures for those who do not comply.

The advocacy effort should target policy makers who influence decisions. These policy makers include the Minister for health, commissioner for health, head of health departments or units related to laboratory services, lawmakers heading health committees, leadership of health facility management boards etc. This could be done by going on an advocacy visit to these individuals. During the visit, the problem of low level of compliance will be explained and its implications. As a result, the need of new policies encouraging the use of task force as oversight and creation of punitive measures for individuals found wanting could be proposed.

To back the efforts of advocacy, another method such as a continuous health campaign through media outlets such as radio, television and even the internet could be useful in bringing the problem and solutions to the notice of policy makers. With all these steps which majorly points to appropriate pressure on relevant stakeholders in the health sector, the problem of low compliance to biosafety guidelines among medical laboratory scientists could be solved.

5.5. Incentives

Incentive is something given to encourage, rouses or motivate (English dictionary 2.3)**.** The government should increase the hazard allowance given to laboratory staffs. Also, scientists that are taking post exposure prophylaxis should be given sick leave during the period that he/she is taking anti retroviral drug. Alternatively, anti retroviral drugs should be kept in laboratory first aid box this will enhance secrecy.

5.6 Conclusion

The laboratory biosafety guidelines were developed to guide government, Industry University, hospital, and other public health and microbiological laboratories in their development of biosafety policies and programs. It also serves as technical document providing information and recommendations on the design, construction and commissioning of containment facilities (Ministry of Health Population and Public Health, 2004).

According to Zaveri and Karia, (2005) a thorough knowledge of the right risk and safety measures to take potentially protects against occupational hazards in the laboratory. Control and proper disposal of laboratory infectious wastes and other wastes reduce environmental contaminations and spread of infections (Bermes and Young, 2001; NEPM, 1991).

Findings from this study have revealed good knowledge of laboratory biosafety guidelines among medical laboratory scientists in Ibadan metropolis and this has significantly influenced their attitude but low compliance. Factors considered by these scientists to affect their compliance include lack of good working facilities such water, washing hand station, fire extinguisher and lack of commodities such as gloves, first aid box, supply of substandard personal protective equipment such as nose mask. Lack of adequate supervision was also stated as one of the issues relating to compliance to laboratory biosafety guidelines.

5.7 Recommendations

Based on the findings of this study, the following important points are recommended to improve the biosafety practice in laboratories:-

- There is need for laboratory managers and stakeholders in laboratories to give sick leave to any laboratory scientist that is using post exposure prophylaxis;
- There is need for the management to make a policy to enforce all laboratory scientist to take hepatitis B immunization;
- There is need for government to increase the hazard allowance given to laboratory scientists; and
- There is need for a new policy on training and retraining of laboratory scientist for an improved safety measure.

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Knowledge, Attitude and Compliance to Laboratory Biosafety Guidelines among Medical Laboratory Technicians in Ibadan Municipal (Questionnaire)

Dear Respondent,

My name is Arowoduye, Bilikisu Oyeronke, a Post Graduate Student in the Department of Health Promotion and Education, Faculty of Public Health, University of Ibadan and I have designed this questionnaire to assess level of Knowledge Attitude and Compliance to biosafety guidelines among Medical Laboratory Technicians in Ibadan Metropolis. All information obtained from respondents will be treated with utmost confidentiality. Your participation is voluntary and you are not obliged to answer any question you do not wish to answer. Do I have your permission to start this interview? Please kindly sign below with date if you consent to participating in this study. Thank you.

____

Serial No _________ Location________

Please tick the answer that is most appropriate to your opinion.

Section A: Demographic Characteristics

1. Age as at last birthday (in years) ____________
2. Sex: 1. Male ( ) 2. Female ( )
3. Marital Status: 1. Married ( ) 2. Single ( ) 3. Others, please specify______
4. Ethnicity: 1. Yoruba ( ) 2. Hausa ( ) 3. Igbo ( ) 4. Others please specify_______
5. Religion: 1. Christianity 2. ( ) Islam ( ) 3. Traditional ( ) 4. Others please specify_______
6. Name of facility ____________________________
7. How many hours do you spend at work? _________________________

8. have you ever attended biosafety training before 1. yes 2. no

Section B: Knowledge on Laboratory Biosafety guidelines

Please tick the answer that is most appropriate to your opinion.

S/N	Questions/Statements	True	False	Don't know
1	Biosafety guidelines are the planning, improvement, and implementation of interventions designed to maintain and improve the health of a group of individuals.			

2	Laboratory biosafety guidelines are guidelines to prevent occupation hazards among laboratory workers			
3	Risk assessment is component of laboratory biosafety guidelines			
4	Disposal of wastes is in the component of laboratory biosafety guidelines			
5	Wearing of leather shoes is not necessary in the laboratory			
6	Preventive measures against hepatitis B and C is not included in the biosafety guidelines			
7	Biosafety guideline is applicable only when handling HIV positive specimen alone			
8	Drinking and eating in laboratory is permissible			
9	Processing of sputum in congested laboratory is permissible			
10	Wearing personal protective gadget is wasting of time especially when there is a lot of work			
11	The hand of laboratory scientist should be washed only after collecting sample from the patients			
12	It is necessary for all laboratory scientist to be immunize against Hepatitis B			
13	Laboratory settings must have eye washing station			
14	Fire extinguishers is not compulsory in the laboratory			
15	Recapping of needle is dangerous to the phlebotomist			
16	Creation of aerosol by centrifuge does not pose any risk to laboratory scientist			
17	All reagent bottles / container should be clearly labeled and carefully arranged in a secured place in laboratory			
18	Biosafety guidelines applies to all patient's sample			

	irrespective previous diagnosis			
19	No form of carpeting is acceptable in the laboratory			
20	Laboratory area with the radioactive materials are to be label with instructions			
21	syringe and other waste can be disposed together			

Section C: Attitude towards Biosafety Guidelines in Laboratory

Please tick the answer that is most appropriate to your opinion.

S/N	QUESTIONS	AGREE	DISAGREE	NOT SURE
1	Hepatitis B are important occupation hazard among laboratory workers			
2	I am not at risk of contracting infectious disease such as HIV			
3	Laboratory scientists cannot contract infectious disease such as hepatitis and HIV as long as they strictly follow biosafety guidelines			
4	There is nothing wrong in eating in laboratory only if it is in clean area			
5	Biosafety guidelines must be followed at all times by laboratory scientist			
6	Biosafety guidelines is too cumbersome			
7	All scientist should not involve in any activities without wearing personal protective equipment			
8	Reuse of gloves save additional cost, therefore it is justifiable			
9	Wearing of leather shoes is inconvenient,			

	therefore it should not be made compulsory			
10	Hanging laboratory apron inside car portray my dignity and high level of identity, therefore I need to hang it			
11	Hanging apron in the car does not pose any kind of risk			
12	Prayers after needle prick cures more than post exposure prophylaxis			
13	Taking hepatitis B immunization is not necessary if other biosafety guidelines are strictly followed			

Section D: Compliance to Biosafety Guidelines
Please underline the most appropriate answer to these questions.

S/N	QUESTIONS	ALWAYS	SOMETIMES	ONCE IN A WHILE	NEVER
1	Work in the laboratory without wearing apron (lab coat)?				
2	Wear open slippers to laboratory?				
3	Perform any laboratory procedure on blood or body fluid without wearing glove?				
4	Pipette with your mouth?				
5	Reuse gloves?				
6	Eat or drink in the laboratory?				
7	Store food or drink in laboratory refrigerator?				
8	Hang your apron (lab coat) in your car after work?				

During the last six (6) month did you ………………………..

9. Experience spillage of specimen on your skin or face? 1. Yes 2. No
9b. If yes to question '9'what did you do?

____

____

10. Experience needle stick injury before? 1. Yes 2. No
10b. Use post exposure prophylaxis? 1. Yes 2. No
11. Are you immunized against hepatitis B? 1. Yes 2. No
11b. Complete the dose? 1. Yes 2. No

Section E: Which of the Following Issues Affect Your Laboratory?

S/N	QUESTIONS	YES	NO
1	Inadequate supply of water		
2	Inadequate supply of gloves		
3	Supply of substandard personal protective equipment such as nose mask		
4	Lack of adequate supervision		
5	Lack of washing hand station		
6	lack of first aid box		
7	Lack of fire extinguisher		
8	Nonchalant attitude of the staff		
9	Working in a congested environment		
10	Inadequate supply of disinfectants		
11	Supply of substandard laboratory disinfectant		
12	Lack of occurrence register in the laboratory to inform the younger scientist about past experience		

Others please specify

____

____

____

____

____

SECTION E: Suggestions on How to Overcome the Barriers facing you in your facility.

Please note: Suggest solutions to problem faced in your facility alone.

1. Inadequate water supply
   ……………………………………………………………………………………
   ……………………………………………………………………………………
2. Inadequate supply of gloves
   ……………………………………………………………………………………
   ……………………………………………………………………………………
3. Supply of substandard personal protective equipment such as nose mask
   ……………………………………………………………………………………
   ……………………………………………………………………………………
4. Lack of adequate supervision
   ……………………………………………………………………………………
   ……………………………………………………………………………………
5. Lack of washing hand station
   ……………………………………………………………………………………
   ……………………………………………………………………………………
6. lack of first aid box
   ……………………………………………………………………………………
   ……………………………………………………………………………………
7. Lack of fire extinguisher
   ……………………………………………………………………………………
   ……………………………………………………………………………………
8. Nonchalant attitude of the staff
   ……………………………………………………………………………………
   ……………………………………………………………………………………
9. Working in a congested environment
   ……………………………………………………………………………………
   ……………………………………………………………………………………
10. Inadequate supply of disinfectants
    ……………………………………………………………………………………
    ……………………………………………………………………………………
11. Supply of substandard laboratory disinfectant
    ……………………………………………………………………………………
    ……………………………………………………………………………………
12. Lack of occurrence register in the laboratory to inform the younger scientist about past experience
    ……………………………………………………………………………………
    ……………………………………………………………………………………

Laboratory Biosafety Levels Adapted to Develop the Questionnaire

Laboratory biosafety describes the containment principles, technologies and practices that are implemented to prevent the unintentional exposure to pathogens and toxins, or their accidental release. Laboratory Biosafety level designations are based on a combination of the design features, construction, containment facilities, equipment, practices and operational procedures required for working with agents for various working groups**.** There are 4 levels of Laboratory facilities designated as BSL 1-4 (WHO, 2007).

2.6.1 Biosafety Level One (BSL-1)

BSL-1 is the basic level of protection required when working with agents that are not known to cause disease in normal healthy humans. BSL-1 requires the lowest level of containment and safety guidelines, which are entirely based on standard laboratory practices, e.g. laboratories that do not work with disease-causing agents or specimens from humans such as school laboratory.

Standard Biosafety Practices

1. The laboratory supervisor must enforce the institutional policies that control access to the laboratory.
2. Persons must wash their hands after working with potentially hazardous materials and before leaving the laboratory.
3. Eating, drinking, smoking, handling contact lenses, applying cosmetics, and storing food for human consumption must not be permitted in laboratory areas. Food must be stored outside the laboratory area in cabinets or refrigerators designated and used for this purpose.
4. Mouth pipetting is prohibited; mechanical pipetting devices must be used.
5. Policies for the safe handling of sharps, such as needles, scalpels, pipettes, and broken glassware must be developed and implemented. Whenever practical, laboratory supervisors should adopt improved engineering and work practice controls that reduce risk of sharps injuries. Precautions, including those listed below, must always be taken with sharp items. These include:

a. Careful management of needles and other sharps are of primary importance. Needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal.
b. Used disposable needles and syringes must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal.
c. Non-disposable sharps must be placed in a hard walled container for transport to a processing area for decontamination, preferably by autoclaving.
d. Broken glassware must not be handled directly. Instead, it must be removed using a brush and dustpan, tongs, or forceps. Plastic ware should be substituted for glassware whenever possible.

6. Perform all procedures to minimize the creation of splashes and/or aerosols.
7. Decontaminate work surfaces after completion of work and after any spill or splash of potentially infectious material with appropriate disinfectant.
8. Decontaminate all cultures, stocks, and other potentially infectious materials before disposal using an effective method. Depending on where the decontamination will be performed, the following methods should be used prior to transport.

a. Materials to be decontaminated outside of the immediate laboratory must be placed in a durable, leak proof container and secured for transport.
b. Materials to be removed from the facility for decontamination must be packed in accordance with applicable local, state, and federal regulations.

9. A sign incorporating the universal biohazard symbol must be posted at the entrance to the laboratory when infectious agents are present. The sign may include the name of the agent(s) in use, and the name and phone number of the laboratory supervisor or other responsible personnel. Agent information should be posted in accordance with the institutional policy.
10. An effective integrated pest management program is required
11. The laboratory supervisor must ensure that laboratory personnel receive appropriate training regarding their duties, the necessary precautions to prevent exposures, and exposure evaluation procedures. Personnel must receive annual updates or additional training when procedural or policy changes occur. Personal

health status may impact an individual's susceptibility to infection, ability to receive immunizations or prophylactic interventions. Therefore, all laboratory personnel and particularly women of childbearing age should be provided with information regarding immune competence and conditions that may predispose them to infection. Individuals having these conditions should be encouraged to self-identify to the institution's healthcare provider for appropriate counseling and guidance.

B. Special Practices None required. C. Safety Equipment (Primary Barriers and Personal Protective Equipment)

1. Special containment devices or equipment, such as BSCs, are not generally required.
2. Protective laboratory coats, gowns, or uniforms are recommended to prevent contamination of personal clothing.
3. Wear protective eyewear when conducting procedures that have the potential to create splashes of microorganisms or other hazardous materials. Persons who wear contact lenses in laboratories should also wear eye protection.
4. Gloves must be worn to protect hands from exposure to hazardous materials. Glove selection should be based on an appropriate risk assessment. Alternatives to latex gloves should be available. Wash hands prior to leaving the laboratory. In addition,

BSL-1 workers should:

a. Change gloves when contaminated, glove integrity is compromised, or when otherwise necessary.
b. Remove gloves and wash hands when work with hazardous materials has been completed and before leaving the laboratory.
c. Do not wash or reuse disposable gloves. Dispose of used gloves with other contaminated laboratory waste. Hand washing protocols must be rigorously followed.

D. Laboratory Facilities (Secondary Barriers)

1. Laboratories should have doors for access control.
2. Laboratories must have a sink for hand washing.
3. The laboratory should be designed so that it can be easily cleaned. Carpets and rugs in laboratories are not appropriate.
4. Laboratory furniture must be capable of supporting anticipated loads and uses. Spaces between benches, cabinets, and equipment should be accessible for cleaning.

a. Bench tops must be impervious to water and resistant to heat, organic solvents, acids, alkalis, and other chemicals.

b. Chairs used in laboratory work must be covered with a non-porous material that can be easily cleaned and decontaminated with appropriate disinfectant.

2.6.2 Biosafety Level Two (BSL-2)

In working with moderate-risk agents that cause human disease of varying severity and transmission is by ingestion, percutaneous or mucous membrane exposure, BSL-2 is employed. Most clinical diagnostic laboratories are in this level. Agents may be handled on open benches, especially if primary barriers, such as facemasks, gowns, and examination gloves are used appropriately. Some procedures may require enhanced containment which includes unidirectional air flow, the use of biological safety cabinets (BSCs) and safety centrifuges. Organisms handled in this level are in risk group 2Biosafety Level 2

Biosafety Level 2 builds upon BSL-1. BSL-2 is suitable for work involving agents that pose moderate hazards to personnel and the environment. It differs from BSL-1 in that: 1) laboratory personnel have specific training in handling pathogenic agents and are supervised by scientists competent in handling infectious agents and associated procedures; 2) access to the laboratory is restricted when work is being conducted; and 3) all procedures in which infectious aerosols or splashes may be created are conducted in BSCs or other physical containment equipment. The following standard and special practices, safety equipment, and facility requirements apply to BSL-2.

A. Standard laboratory Practices

1. The laboratory supervisor must enforce the institutional policies that control access to the laboratory.
2. Persons must wash their hands after working with potentially hazardous materials and before leaving the laboratory.
3. Eating, drinking, smoking, handling contact lenses, applying cosmetics, and storing food for human consumption must not be permitted in laboratory areas. Food must be stored outside the laboratory area in cabinets or refrigerators designated and used for this purpose.
4. Mouth pipetting is prohibited; mechanical pipetting devices must be used.
5. Policies for the safe handling of sharps, such as needles, scalpels, Pipettes and broken glassware must be developed and implemented. Whenever practical, laboratory supervisors should adopt improved engineering and work practice controls that reduce risk of sharps injuries. Precautions, including those listed below, must always be taken with sharp items. These include:
   a. Careful management of needles and other sharps are of primary importance. Needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal
   b. Used disposable needles and syringes must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal.
   c. Non-disposable sharps must be placed in a hard walled container for transport to a processing area for decontamination, preferably by autoclaving.
   d. Broken glassware must not be handled directly. Instead, it must be removed using a brush and dustpan, tongs, or forceps. Plastic ware should be substituted for glassware whenever possible.
6. Perform all procedures to minimize the creation of splashes and/or aerosols.
7. Decontaminate work surfaces after completion of work and after any spill or splash of potentially infectious material with appropriate disinfectant.
8. Decontaminate all cultures, stocks, and other potentially infectious materials before disposal using an effective method. Depending on where the decontamination will be performed, the following methods should be used prior to transport:

a. Materials to be decontaminated outside of the immediate laboratory must be placed in a durable, leak proof container and secured for transport.

b. Materials to be removed from the facility for decontamination must be packed in accordance with applicable local, state, and federal regulations.

9. A sign incorporating the universal biohazard symbol must be posted at the entrance to the laboratory when infectious agents are present. Posted information must include: the laboratory's biosafety level, the supervisor's name (or other responsible personnel), telephone number, and required procedures for entering and exiting the laboratory. Agent information should be posted in accordance with the institutional policy.

10. An effective integrated pest management program is required.

11. The laboratory supervisor must ensure that laboratory personnel receive appropriate training regarding their duties, the necessary precautions to prevent exposures, and exposure evaluation procedures. Personnel must receive annual updates or additional training when procedural or policy changes occur. Personal health status may impact an individual's susceptibility to infection, ability to receive immunizations or prophylactic interventions. Therefore, all laboratory personnel and particularly women of childbearing age should be provided with information regarding immune competence and conditions that may predispose them to infection. Individuals having these conditions should be encouraged to self-identify to the institution's healthcare provider for appropriate counseling and guidance.

B. Special Practices

1. All persons entering the laboratory must be advised of the potential hazards and meet specific entry/exit requirements.

2. Laboratory personnel must be provided medical surveillance, as appropriate, and offered available immunizations for agents handled or potentially present in the laboratory.

3. Each institution should consider the need for collection and storage of serum samples from at-risk personnel.

4. A laboratory-specific biosafety manual must be prepared and adopted as policy. The biosafety manual must be available and accessible.

5. The laboratory supervisor must ensure that laboratory personnel demonstrate proficiency in standard and special microbiological practices before working with biosafety level two agents

6. Potentially infectious materials must be placed in a durable, leak proof container during collection, handling, processing, storage, or transport within a facility.

7. Laboratory equipment should be routinely decontaminated, as well as, after spills, splashes, or other potential contamination.

a. Spills involving infectious materials must be contained, decontaminated, and cleaned up by staff properly trained and equipped to work with infectious material.

b. Equipment must be decontaminated before repair, maintenance, or removal from the laboratory.

8. Incidents that may result in exposure to infectious materials must be immediately evaluated and treated according to procedures described in the laboratory biosafety manual. All such incidents must be reported to the laboratory supervisor. Medical evaluation, surveillance, and treatment should be provided and appropriate records maintained.

9. Animal and plants not associated with the work being performed must not be permitted in the laboratory.

10. All procedures involving the manipulation of infectious materials that may generate an aerosol should be conducted within a BSC or other physical containment devices.

C. Safety Equipment (Primary Barriers and Personal Protective Equipment)

1. Properly maintained BSCs, other appropriate personal protective equipment, or other physical containment devices must be used whenever:

a. Procedures with a potential for creating infectious aerosols or splashes are conducted. These may include pipetting, centrifuging, grinding, blending, shaking, mixing, sonicating, opening containers of infectious materials, inoculating animals intranasally, and harvesting infected tissues from animals or eggs.

b. High concentrations or large volumes of infectious agents are used.

Such materials may be centrifuged in the open laboratory using sealed rotor heads or centrifuge safety cups.

2. Protective laboratory coats, gowns, smocks, or uniforms designated for laboratory use must be worn while working with hazardous materials. Remove protective clothing before leaving for non-laboratory areas, e.g. cafeteria, library, and administrative offices. Dispose of protective clothing appropriately, or deposit it for laundering by the institution. It is recommended that laboratory clothing not be taken home.

3. Eye and face protection (goggles, mask, face shield or other splatter guard) is used for anticipated splashes or sprays of infectious or other hazardous materials when the microorganisms must be handled outside the BSC or containment device. Eye and face protection must be disposed of with other contaminated laboratory waste or decontaminated before reuse. Persons who wear contact lenses in laboratories should also wear eye protection.

4. Gloves must be worn to protect hands from exposure to hazardous materials. Glove selection should be based on an appropriate risk assessment. Alternatives to latex gloves should be available.

Gloves must not be worn outside the laboratory. In addition,

BSL-2 laboratory workers should:

a. Change gloves when contaminated, glove integrity is compromised, or when otherwise necessary.
b. Remove gloves and wash hands when work with hazardous materials has been completed and before leaving the laboratory.
c. Do not wash or reuse disposable gloves. Dispose of used gloves with other contaminated laboratory waste. Hand washing protocols must be rigorously followed.

5. Eye, face and respiratory protection should be used in rooms containing infected animals as determined by the risk assessment.

D. Laboratory Facilities (Secondary Barriers)

1. Laboratory doors should be self-closing and have locks in accordance with the institutional policies.

2. Laboratories must have a sink for hand washing. The sink may be manually, hands-free, or automatically operated. It should be located near the exit door.

3. The laboratory should be designed so that it can be easily cleaned and decontaminated. Carpets and rugs in laboratories are not permitted.

4. Laboratory furniture must be capable of supporting anticipated loads and uses. Spaces between benches, cabinets, and equipment should be accessible for cleaning.

a. Bench tops must be impervious to water and resistant to heat, organic solvents, acids, alkalis, and other chemicals.

b. Chairs used in laboratory work must be covered with a non-porous material that can be easily cleaned and decontaminated with appropriate disinfectant.

5. Laboratory windows that open to the exterior are not recommended. However, if a laboratory does have windows that open to the exterior, they must be fitted with screens. Examples of infectious organism in Biosafety level two are: Measles virus, Salmonellae, Toxoplasma spp., Hepatitis B virus

Note: Immunization or antibiotic treatment is available

2.6.3 Biosafety Level Three (BSL-3)

BSL-3 is an enhanced level 2 appropriate for work with indigenous or unusual agents (in risk group 3) that have a known potential for aerosol transmission and that can cause serious and potentially fatal infections such as TB. It has additional features to prevent transmission of infectious organisms which include unidirectional airflow, appropriate respiratory protection, HEPA filtration of exhausted laboratory air and strictly controlled laboratory access.

2.6.4 Biosafety Level Four (BSL-4)

BSL-4 is designed for use with exotic agents (risk group 4) that have the potential for aerosol transmission, often having a low infectious dose and produce very serious and often life threatening disease; there is generally no treatment or vaccine available, such as hemorrhagic fever viruses. Workers who perform procedures in these laboratories require special training and they wear full-body, air-supported, positive-pressure suits. In addition, the facility itself must be totally isolated from other laboratories and have specialized ventilation and waste-management systems.

Compliance to laboratory Biosafety guidelines coding guide

Variable	Coding guide
Work in the laboratory without wearing apron (lab coat)?	
Always	3
Sometimes	2
Once in a while	1
Never	0
Wear open slippers to laboratory?	
Always	3
Sometimes	2
Once in a while	1
Never	0
Perform any laboratory procedure on blood or body fluid without wearing glove?	
Always	3
Sometimes	2
Once in a while	1
Never	0
Pipette with your mouth?	
Always	3
Sometimes	2
Once in a while	1
Never	0
Reuse gloves?	
Always	3
Sometimes	2
Once in a while	1
Never	0
Eat or drink in the laboratory?	
Always	3
Sometimes	2
Once in a while	1
Never	0
Store food or drink in laboratory refrigerator?	
Always	3
Sometimes	2
Once in a while	1
Never	0
Hang apron (lab coat) in my car after work?	
Always	3
Sometimes	2
Once in a while	1
Never	0

Compliance to laboratory Biosafety guidelines coding guide

Variable	Coding guide
Change gloves between tasks and procedures on the same patient after contact with material that may contain a high concentration of microorganisms?	
Always	3
Sometimes	2
Once in a while	1
Never	0
Forget wearing personal protective gadget especially when there is a lot of work	
Always	3
Sometimes	2
Once in a while	1
Never	0
Have you ever experience spillage of specimen on your skin or face during laboratory procedures?	
Yes	1
No	0
If yes to question 'what did you do?(N=29)	
Washed with running water	4
Washed affected part with soap	6
Applied treatment	3
Clean immediately with swab	1
Use disinfectant and cotton wool	2
Washed with soap and disinfectant	7
Go to the bathroom to bath	5
Experience needle stick injury before?	
Yes	1
No	0
No response	
Have you use post exposure prophylaxis?	
Yes	1
No	0
Are you immunized against Hepatitis B?	
Yes	1
No	0
If yes, did you complete the dose? (N=78)	
Yes	1
No	0