OCCUPATIONAL SAFETY AND HEALTH STATUS IN MEDICAL LABORATORIES IN KAJIADO COUNTY, KENYA (2017-2018)

FRIDAH NTINYARI TAIT

MASTERS OF SCIENCE

(Occupational Safety And Health)

JOMO KENYATTA UNIVERSITY OF

AGRICULTURE AND TECHNOLOGY

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Occupational safety and health status in medical laboratories in Kajiado County, Kenya (2017-2018)

Fridah Ntinyari Tait

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

Signature ……. Date……

Fridah Ntinyari Tait

This thesis has been submitted for examination with our approval as University supervisors.

Signature..... Date……

Dr. Charles Mburu,, PhD
JKUAT, Kenya

Signature..... Date……

Prof. Joseph Gikunju,
JKUAT, Kenya

DEDICATION

This study is dedicated to my dear husband Tait and my children for their love, support, care, encouragement and understanding during the entire period of study.

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This work would not have been completed without enormous input and support from the following;

First I wish to thank our Almighty God for giving me strength, knowledge, and patience as I carried out this study.

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LIST OF ABBREVIATIONS AND ACRONYMS

DHS	Demographic Health Survey
DOSHS	Directorate of Occupational Safety and Health Services
EHS	Emergency Health Services
EH&S	Environmental Health and Safety
GOK	Government of Kenya
HCP	Health Care Personnel
HCWs	Health Care Workers
IIPP	Injuries and Illness, Prevention Programme
ILO	International Labour Organization
ILO-OSH	International Labour Organization-occupational Safety and Health
IOHA	International Occupational Hygiene Association
MHSW	Management of Safety and Health at Work
MODU	Major Organizations Development Unit
NALGO	National and Local Government Officers' Association
OHNC	Occupational Health Nursing Certificate
OHND	Occupational Health Nursing Diploma
OSH	Occupational Safety and Health

OSHA	Occupational Safety and Health Act
PEP:	Post Exposure Prophylaxis
PMT	Protection Motivation Theory
PPEs	Personal Protective Equipment's
PPMCC	Product Moment Correlation Coefficient
SOPs	Standard operating procedures
S&H	Safety and Health

DEFINITION OF TERMS

Biological hazard: This refers to macro, micro-organism or its by products that is harmful to other organisms such as human beings.

Chemical Hazards: This refers to a type of occupational hazard caused by exposure to chemicals in the workplace.

Medical laboratories: These are facilities where clinical pathology tests are conducted on clinical specimens to obtain information on the health of a patient to help health care professionals to diagnose, treat and prevent diseases.

Occupational safety and health (OSH): Refers to multidisciplinary concept that focuses on welfare, health and safety standards of individuals.

Physical Hazards: This refers to an agent, factor or circumstance that can cause harm with or without contact.

ABSTRACT

Medical laboratories can be dangerous to work in and have been associated with serious occupational exposures that expose health workers to numerous potential hazards thus warranting effective mitigatory measures. It is estimated that every day, around the world, 6300 individuals die due to job-related, accidents and diseases and this attributes to 2.3 million annual deaths. More than 337 million workplace accidents are result of poor health practices and occupational safety. In spite of increase in OSH interest, the available studies conducted in developing nations have focused medical laboratories' OSH in general and a larger number of workplace injuries occur without proper documentation. The present study evaluated the status of medical laboratories' OSH within Kajiado County, Kenya. The objectives entailed establishment of chemical, physical and biological hazards; reviewing control measures in medical laboratories and enumerating factors affecting implementation of good OSH practices. The study adopted cross-sectional research design. The study used interview schedules, structure questionnaire, interview and observation checklists. The researcher was conducted in 108 medical laboratories in Kajiado County and the sampled participants were 204. Statistical package for Social Science (SPSS version 20) was used in analysis of data. The results revealed that the most common type of hazard in the medical laboratories were biological hazard (bacteria 80%), chemical hazards (handling of unmarked and unlabeled chemical contributed to 38.2%) and physical hazards (dangerous placing of laboratory equipment contributed to 49.5%). The study also found that control measures among medical laboratory staff include BCG vaccination (95%), proper waste disposal equipment in medical facilities (92.6%), HIV screening (87%), Hepatitis B vaccination (82%), hand washing practices, provision of post exposure prophylaxis (PEP) (72%) and use of personal protective equipment (PPE) (60%). Further, the factors hindering implementation of good practices among medical laboratory staff in Kajiado County include negative attitude on OSH (47.1%), inadequate resources/ infrastructure (41.2%), Poor design of lab (39.7%), lack of policy on occupational health safety in the facilities (34.8%), inadequate training on OHS (29.4%), ignorance/lack of awareness (26.5%), lack of personal protective equipment(s) (8.8%) and poor ergonomics (5.9%). The study recommends that occupational health and safety guidelines of medical laboratories should be ratified and adopted as well as effectively communicated to all stakeholders as required by the law so as to guide individuals in hazard management in medical laboratories. In addition, the management of medical laboratories in Kajiado County should develop internal policies to prevent biological, chemical and physical hazards. Further, there should be training of all workers on OSH as per the OSHA, 2007 regulations. The training should also cover importance of screening and vaccinations, use of PPE, use of PEP among other practices as control measures for hazards in the laboratories. Also, the management of medical laboratories should provide adequate resources/ infrastructure to enable the implementation of good practices among medical laboratory staff. Also, the management should provide personal protective equipment(s) and proper ergonomics for utilization in laboratories.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

During the industrial revolution era, the labor union movements were initiated due to workers outcry due on health complications attributed to job-related issues thus making research and occupational- safety regulations relatively recent phenomena. The seriousness of the hazards at workplace associated with Occupational Safety and Health dates back to the beginning of the 20th century. It was so serious that a short history of workplace Safety and Health in the United States early 1920s has been documented in all manner of forms including in cinemas, videos, pictures, etc. "Can't Take No More," is a 1979 film taken from the Occupational Safety and Health Administration (OSHA) documentation in the USA (Krueger, 1981).

Krueger (1981) indicated that provision of occupational safety among staff, in their working area is a moral dimension that is paramount. In spite of the fact that it is a legal requirement and entails monetary compensation, for failure to adhere to occupational and health safety standards, it cannot resurrect individuals who lose their life due to work-related complications. Besides that, Krueger (1981) noted that elimination of the potential causes of injuries or accidents, guiding and counseling of organizational staff plays an integral role in saving firm's operational costs, thus, increasing overall productivity and enhance dependability of employees.

In Kenya, the status of Occupational Safety and Health (OSH) conditions has been area of concern. Issues relating to OSH in the state of Kenya can be tracked back from early 1951 after the implementation of Factories. Ordnance Act, which was amended to become the Factories' Act Cap 514 as stipulated in the constitution of Kenya at that time.

In the year 2004, the Kenya government gazetted the Factory and Workplace legislation under the legal notice number 31. The legislation emphasized on creation of Safety Committees among firms that had employed at list 20 staff. The mandates of the committees were to conduct safety audits and ensure effective implementation of OSH. Nonetheless, most of job-related injuries and accidents went unattended and unreported. This necessitated that the establishment of Occupational Safety and Health Act (OSHA) 2007 so as to provide detailed approaches on OSH issues (Nyakang'o, 2005).

The Directorate of Occupational Safety and Health Services (DOSHS) is charged with the responsibility of managing OSH. The national authority is designated for collecting OSH data, maintaining database, analysing and investigating job-related diseases, injuries, accidents among other occupational hazards. The Directorate's legislations are stipulated in the National Occupational Safety and Health Policy (2012), WIBA 2007 and OSHA 2007. The National Council for Occupational Safety and Health (NACOSH) is the national body that is responsible for reviewing, OSH legislation, actions and policies. The NACOSH comprise of the Central Organization of Trade Unions (Kenya) (COTU-K) and Federation of Kenya Employers (FKE) (Nyakang'o, 2005).

The other legislation that touch on Occupational Safety and Health in Kenya are as follows: The Kenyan constitution (2010), HIV / AIDS Workplace policy, Work Injury Compensation WIBA Act (2007), Building code (1968), Pest Control Product Act, Radiation Protection Act (Cap.243), Pharmacy and Poisons Act (Cap. 244), Public Health Act CAP 242, Pest Control Products Act Cap 346, TB / IPC guidelines (2009),), Health Care Waste Management manual (2009), Environmental Management and Coordination Act (1999), Injection Safety and Waste Management policy (2007) among others. Various government departments and ministries are responsible for enforcing these laws across all 47 Counties in Kenya.

Medical laboratories are facilities where clinical pathology tests are conducted on clinical specimens to obtain information on the health of a patient to help health care professionals to diagnose, treat and prevent diseases. The functions of medical

laboratories include examination analysis of blood fluids, blood and urine. Other functions include blood grouping, bacteria culture, Rh typing, biochemistry, urine analysis, immunology, serology, and hormonal assays among others (Antonelli *et al.,* 2017).

Currently, many people are being employed in medical laboratories than in the past years due to the growing number of clinical investigations available and therefore an increased need for technicians and technologists to perform the tests. For instance, the number of medical laboratory technologists increase from 0.01 in 1990s to 1.3 per 1,000 inhabitants in 2017, globally. The employees are more likely to be exposed on various workplace hazards depending on the equipment they are using as well as the methods adopted when performing their duties. Some of work-related complications cannot be realized until unforeseen, accident, illness, death and accident occurs. Most of staff in healthcare sector are vulnerable or susceptible to blood-borne pathogenic infections compared to the general population (Nsubuga & Jaakkola, 2005). To shed more light, the most vulnerable are those staffs who activities may subject the into physical constant with patients' body fluids that have HIV, Hepatitis B and Hepatitis C infections (Rantanen, 1996).

It is estimated that every day, around the world, 6300 individuals die due to job-related, accidents and diseases and this attributes to 2.3 million annual deaths. More than 337 million workplace accidents is as a result of poor health practices and occupational safety (Ndejjo, 2015). Nonetheless, the rate of both reported and unreported job-related injuries is strongly believed to be much higher and there is no data on specific OSH among the medical laboratories that has been explicitly documented.

Medical laboratories handle wide varieties of materials that are potentially dangerous pathogenic agents. Some of the samples collected contain pathogenic agents for example *Mycobacterium tuberculosis* in sputum specimens, blood borne pathogens like Hepatitis B, C & HIV, brucellosis and many others. Sharps injuries contribute over 30% of new Hepatitis B cases and 2.5 percent annual HIV infections among health-workers in Sub-Saharan States in Africa (Prüss-Üstün, Rapiti, & Hutin, 2005).

In addition to handling of material that can injure them, medical laboratories use chemical agents, gases and solvents that constitute non-biological hazards. The agents can be toxic, explosive, inflammable, toxic in nature, hence, can results to explosions in laboratories (Pohanish Richard, 2003).

Laboratories are subjected to physical hazards such as electrical hazards, ergonomic hazards, electrical hazards that are often associated with the manner in which equipment are used or handled in organizational settings *(Manyele et al., 2013*). Noise from equipment such as centrifuge could also be detrimental to the ears. The workers are also faced with ergonomic hazards such as sitting on very high chairs which can cause musco-skeletal disorder due to prolonged standing and repetitive tasks.

According to Manyele *et al.* (2008), the main role of OSHA, 2007 is to ensures protection of welfare of individuals at workplace, secure their safety and projects unsusceptible from occupational hazards due to activities conducted at the workplace.

This study therefore sought to establish the biological, chemical, and physical hazards that medical workers are exposed to; reviewing medical laboratories control measures that are put in place; and enumerating the different factors that hinder implementation of good practice in OSH for medical laboratories.

1.2 Statement of the problem

Occupational safety and health programs in Kenya have largely been concentrated and directed towards mining and manufacturing establishments. However, little has been done on other work environments such as medical laboratories. This is despite more than 250 medical laboratory technicians and technologists getting employed as staff of this equally fast growing sector in the world including in Kajiado County of Kenya. Medical laboratories can be dangerous to work in and have been associated with serious occupational exposures which warrant effective mitigatory measures. These workers are constantly exposed to many occupational safety and health hazards associated with the handling of materials, objects and testing instruments

that are likely to cause chemical, biological and physical harm. In addition, there has been no documented attempt in Kenya in the past to evaluate the OSH status in medical laboratories with a view to determine the adequacy of preventive and protective measures in place. It is in line with the aforementioned that this research sought to assess and document the status of OSH in medical laboratories at Kajiado County.

1.3 Justification

Workplace accidents are common in Kenya, where 64 fatalities per 100,000 staff are experienced every year. The Occupational Safety and Health Act (2007) states that it is the employer's obligation to provide a safe working environment for the workers. Therefore, the study's findings may be essential to the employers of medical laboratories staff and the government of Kenya.

This study's findings will enlighten on issues for key areas of intervention especially in the integration of occupational health services into the laboratory departments of clinical laboratories in Kajiado County. This study aimed at evaluating the occupational-safety and health status of medical laboratories within Kajiado County. . It sought to determine the types of hazards in the laboratories, worker's awareness level while at work, effects of the hazards and the safety measures in place. The study will give recommendations that will assist to overcome any hazards that pose danger to the workers, and the environment they are working in.

This study will help the researcher, management of medical laboratories and policy makers to understand the level of awareness, knowledge, practices, and hazards affecting the laboratory workers and document the key factors that encourage and those that inhibit discharge of the occupational Safety and Health policy. This study's results will also give information on issues for key areas of involvement especially documentation of the extent to which the compliance status of medical laboratories to the Occupational Safety and Health regulations in the medical laboratory departments in Kajiado County

1.4 Main Objective

To establish the occupational safety and health status of medical laboratories in Kajiado County

1.4.1 Specific Objectives

1. To determine biological, chemical and physical hazards among medical laboratory staff in Kajiado County.
2. To establish control measures among medical laboratory staff in Kajiado County
3. To determine factors that hinder implementation of good practices among medical laboratory staff in Kajiado County

1.5 Research questions

1. What are the biological, chemical and physical hazards among medical laboratory staff in Kajiado County?
2. What control measures among medical laboratory staff in Kajiado County?
3. What are the factors that hinder implementation of good practices among medical laboratory staff in Kajiado County?

1.6 Scope of the Study

This study generally focused on the Occupational Safety and Health status of medical laboratories in Kajiado County. The study focused on 118 licensed medical laboratories (private and public medical laboratories) in Kajiado County. The population of the study was 250 registered medical laboratory technicians and technologists.

1.7 Conceptual Framework

Conceptual framework is defined as a diagrammatic presentation of the relationship between two or more elements under investigation and the study's concepts. Figure

1.1 shows the relationship between independent variables, intervening variable and moderating variable. The independent variables include chemical hazards, physical hazards and biological hazards. The dependent variable was good practices in occupational safety and health in medical laboratories.

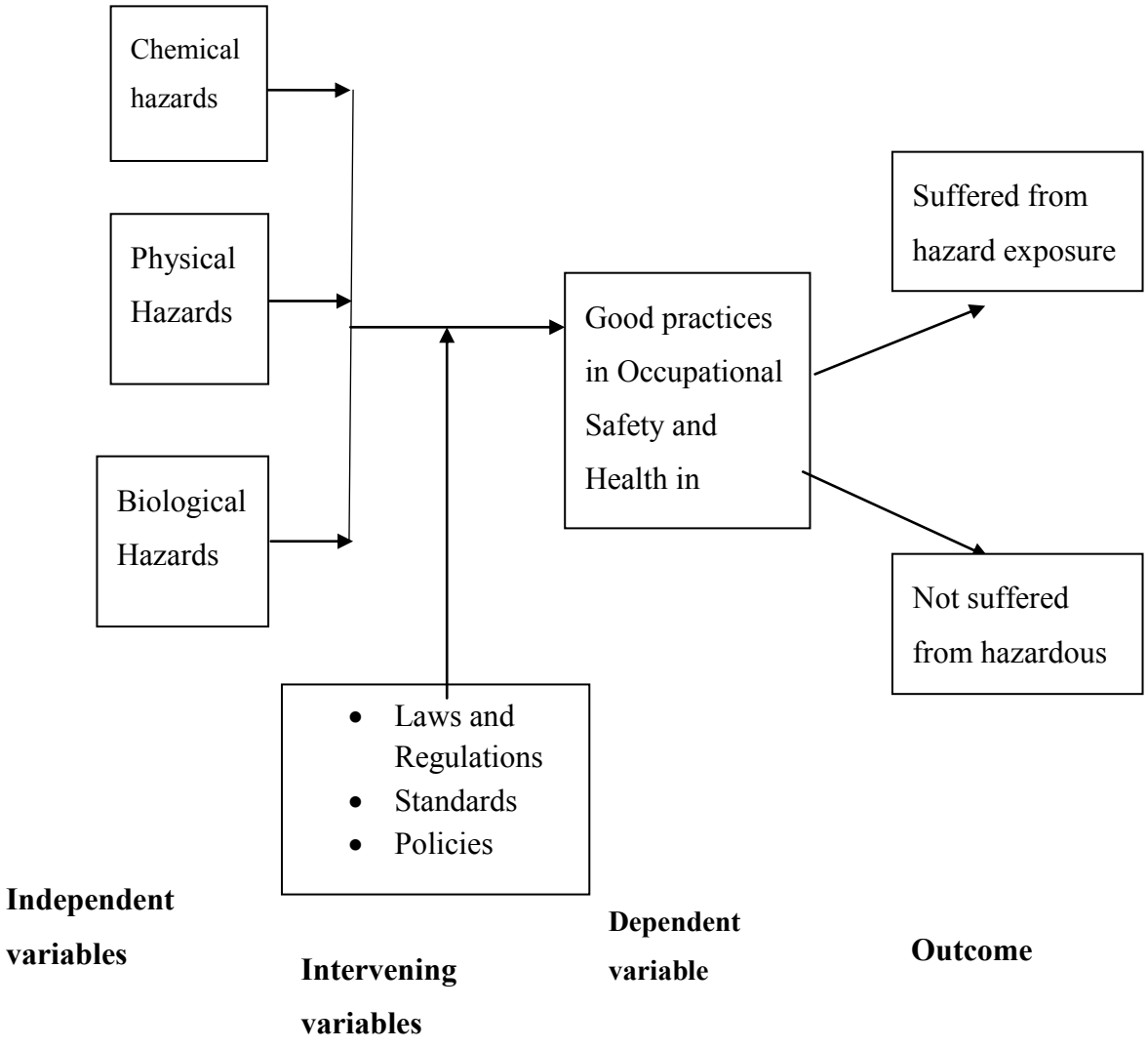

Figure 1. 1: Conceptual framework on occupational safety and health status of medical laboratories in Kajiado County, Kenya

CHAPTER TWO

LITERATURE REVIEW

2.1 The Concept of Occupational Safety and Health

World Health Organization has defined Occupational Safety and Health as the actions for occupational psychology, occupational psychology, occupational medication, ergonomics, rehabilitation and occupational safety. Otherwise safety entails protection of individuals from physical injuries (World Health Organization, 2002). The International Occupational Hygiene Association (IOHA) defines the OSH as the scientific anticipation, evaluation and recognition, controlling of hazards that emanate from area of work and can lead to illness, impair overall well-being of employees, taking into consideration the potential impact surrounding workplace environment and community at large (Carter, 2010). Henceforth, occupational health and safety is concerned with promoting and maintain the highest degree of metal, social and physical well-being of workers or staff in all occupations (World Heath Organization, 2002).

Health and safety are conditions or factors that tend to affect, or has potential effects on the overall well-being of workers including: the workers on contract, permanent and temporary workers, visitors and other individuals within workplace vicinity (World Health Organization, 2002).

For operational purposes, the present study adopted Health and Safety at medical laboratories to include: a place where workers and their employers team up to adopt a constant improvement processes that tend to protect, promote safety, well-being and good health among medical-laboratory staff and ensure medical laboratories' sustainability. Consideration of the following prerequisites tends to enhance the achievement: the level of hazard susceptibility or exposure in the area of work, control mechanisms in the area of work, impediments of good practices with respect to occupational, health and safety practices within the medical laboratories.

In USA, the Occupational Safety and Health Act of 1970 guide Occupational Safety and Health practices in the country. The Act seeks to eliminate workplace injuries, fatalities as well as illness (Howard & Hearl, 2012). However, although OHS regulations that have been developed normally regulated by federal-governmental agency and the OSHA. However, each of the states can opt to develop and implement its own programme. In Nigeria, Occupational Safety and Health Act of 2006 set guidelines for the Occupational Safety and Health. The main goal of this Act is to enhance improvement in health performance and occupational safety in all sector of economic development, not excluding medical laboratories (Umeokafor *et al.,* 2014).

In Ghana, the Labor Act 2003, Act 651, Part XV, sections 118 to 120 gives a guideline on employers' and employers' roles and responsibilities in the management of Occupational Health, Safety and Environment, including: injuries, damage of property, illness the incident when the loses occur in various workplace settings. In Kenya, Occupational Safety and Health is guided by the Occupational Safety and Health Act 2007.

2.2 Theoretical Review

2.2.1 Protection Motivation Theory

The protection Motivation Theory presents the theoretical concept of comprehending fear appeals. Snyder & Deaux (2012) provided the revision of the protection theory to the general theory of persuasive communication, with more emphasis in how cognitive processes mediate change of individual's behavior (Boer & Seydel, 1996; Harrow *et al.*, 2012; Snyder & Deaux, 2012).

This theory partially bases itself on the seminal work of Passiment (2006) and explicitly describes maladaptive and adaptive mechanism of coping up with health risk or threats due to two appraisal processes. The behavioral options tend to diminish threats through evaluation, based on threat appraisal processes and coping appraisal processes. Appraising coping responses and health threats tend to trigger the intent for performing adaptive responses through motivational projects and this may ultimately lead to maladaptive responses. Maladaptive responses are those

which subject workers to potential health risk. They comprise of individuals behaviors that results to tremendous negative impacts and behavioral absence further result to negative impacts or consequences (Passiment, 2006; Thompson *et al.*, 2009).

Protection motivation is as a result of coping threats and appraisal threats. Appraisal of threat refers to estimation of the possibility of contracting a particular infection or disease and estimation of the seriousness and rate of the disease transmission. Coping appraisal comprise of the level of both self-efficacy and response efficacy. Response efficacy is defined as the expectancy of individual's level of expectancy that suggests recommendations to eliminate potential threat. Self-efficacy refers to a strong belief on the ability of an individual to successfully execute recommendable causes of action. Protection motivation is therefore mediating variables whose main role is to trigger, sustain and provide directions on protective health behaviors (Boer & Seydel, 1996). Most of empirical attentions are based on severity and vulnerability of response efficacy and belief that recommended action is very effective is eliminating or reducing potential threat and perceived self-efficacy that the belief an individual can successfully execute recommended actions (Malone, 2011). Thus, a person will be more motivated to protect him-self or her-self. Henceforth, an individual much motivated to protect himself or herself.

The theory affirms that intrinsic rewarding are the perceived positive psychological and physical effects that are resultants of engaging in risky behavior while extrinsic rewards are perceived social and consequence or reaction of engaging in risky behaviors. The overall perception of much greater threat is to decrease the selection and adopting maladaptive behaviors while the perception of greater rewards are to increase probability of selecting maladaptive behaviors (So-kum Tang *et al.*, 2011).

In this study using this model specific Protection Motivation Theory (PMT) variables are manipulated in experimental factorial design and their influence of behavior and intention are measured. Hence, this theory is very unique compared to other social cognition model in relation to relatively larger experimental tests that have been performed (Kibek, 2008).

2.2.2 Institutional theory

The Institutional theory id one of the leading Occupational health and safety theories that is directly related to the key role of national context in influencing health legislations and occupational safety. The theory explicitly elaborate the deeper social-structural aspects. The attributes of this theory are well formulated in a manner that take into consideration the processes by schema, regulation, norms, routines and nature are becoming recognized as the social-conduct's commanding guidelines. It is very unique on how the essential are diffused, developed and become adopted with a prolong period of time and how they can fall into disuse and decline (Kaplan & Burgess, 2010).

The theory is relevant in the present study since it provides more explicit mandate of operating an institution. It also provides guiding principles for daily operational activities among institutions in a particular state. In addition, the attributes are unidirectional thus shape the process of formulating OSH practices in various institutions. Further, this theory provides guidelines that are supposed to be followed when identifying key OSH practices that can be undertaken based on institutional and social structures within the medial laboratories.

2.3 Empirical review

2.3.1 Biological, chemical and physical hazards that face medical laboratory workers.

The ILO/WHO Committee in regards to Occupational Health emphasizes on the workers protection in their employment from risks consequential from factors related to health, the prevention amongst workers of issues from health triggered by conditions in their working areas, maintenance and promotion of the highest level of mental, social and physical well-being of workers in all occupations, the adaptation of work to man and of every man to his job, and maintenance and placing of workers in conducive occupational environment that are compatible with their psychological and physiological capabilities (Burton, 2010).

Laboratory staff are more vulnerable to various forms of hazards since laboratory environments can be hazardous area of work.

These hazards include chemical, biological and physical hazards, as well as musculoskeletal stresses. Masilamani (2010) indicate that laboratory standards were set so as to regulate utilization of chemicals and prevent laboratory staff from exposure to chemical hazardous risks. For example, the African region is likely to be struggling with a number of OSH challenges as the Regional Committee for Africa Report (2004) stipulated that it is linked to the poor performance and endemic poverty on economies of African countries. Additionally, this report implied that Africa's challenge is how to make certain that formal and informal sector have health, which is adequate and can manage to use this information actively to improve practices of safety and health (Masilamani, 2010; Wilburn & Eijkemans, 2004).

Medical-laboratories' staff are exposed to various forms of occupational hazards. Some of the hazards include: laboratory-acquired infections and general laboratory risks attributed to laboratory practices: physical injuries, gassings, fire and explosions (Sulkin & Pike, 1951). Very few epidemiological studies regarding laboratory populations have been conducted. Reid (1957) established that most of the staff who were working in British medical laboratories were exposed to tuberculosis risk infections between the rate of 2 and 9 time compared to the national rates. The study also found that the laboratory staff were exposed to chemical hazards. Anthony and Thomas (1970) noted that most of the paramedical and medical staff in USA experienced Bladders tumours and most of the chemists died from pancreas carcinoma and Lymphotamata.

2.3.1.1 Biological Hazards

Biohazard or biological hazard is defined as macro or micro-organism and its by products that is potentially harmful to other organisms such as human being. Some examples of biohazards include: medical waste, toxins emanating from other living organisms, viruses, fungi and bacteria. Biohazard symbol in any material indicate that the material should be handle with utmost caution. The symbol is a commonly used in hospitals and medical laboratories. The biological hazards have various

degrees of severity and precautions adopted when handling, disposing and storing them accordingly (bin Othman, 2015).

Masilamani (2010) indicates that the potential for a biological hazard to be transmitted from person to person may differ. All precautions must strictly be observed by those handling materials which are biologically hazardous. Failure to handle the materials appropriately could cause a major occurrence of deadly diseases.

By using syringes and discarded dressings, hospital staff are routinely exposed to potentially hazardous materials. These are usually put into particular, noticeably containers and marked bags for incineration. According to Gile (2004), basic hygiene-practices such as disinfection of surfaces and frequent washing of hands combined with the use of disposable gloves assists to thwart these materials from leading to disease (Gile, 2004). Meyer and Eugene (1977) argues that disputed of the fact that some biological agents are potentially lethal, they can be used in development of new medicines and vaccinations. Alternative treatment methods or new compounds are often researched on and identified since some pathogens such as bacteria become resistant to antibiotics (Clinical Laboratory Standards Institute document M29-A3, 2005). The Requirement of the development and testing of new vaccines is rendered by the fact that they are made ineffective because some viruses mutate rapidly. There has never been a vaccine in other cases. Research into hazardous pathogens, or microorganisms, is conducted at highly specialized establishments that utilize a range of equipment, procedures and precautions to prevent escape and infection (Meyer, 1977).

According to Fitzpatrick (2004), biohazards are classified into six categories contacts with contact with an animal that is infected, contact with animal products that are contaminated, insect bites, contact with animal and animal waste, contact with infected body fluids of a particular patient or laboratories' specimen and raising of dust that contain pathogenic organisms (Fitzpatrick, 2004).

Masilamani (2010) established that in medical facilities, the most of occupational accidents involve contact with contaminated body fluids by various healthcare staff and this can lead to emergency and development of infectious diseases. Occupational exposure among the staff working in medical laboratories can be as a result of indirect and direct factors. Some examples of the factors include: physical contact when attending to patients, when taking samples for medical assessment, work overload and unfavourable working conditions. Healthcare staff are exposed to various forms of bio hazards such as backbone injuries, job stress, latex allergies, needle-stick injuries among others. Occupational exposure to infectious agents are devastating to the victims. According to Masilamani (2010) noted that *Vibrio cholerae* are rare infectious occupational disease but often result to laboratory-associated malady. The first indigenous case of cholera in the state of Australia was documented in after a period of more than fifty years was that of twenty-three years old scientist (micro biologist) who was working on viable *V. cholerae* for a duration of four weeks when conducting practical-laboratory course.

According to Pike (1976), viruses, bacteria and reckettsiae were the main causes of laboratory-acquired infections. The main routes of the infections were through aerosols leading to development and utilization of laminar flow bio-safety cabinets. Pike also tabulated the main sources of infections by using the year 1976 panel data from other published literatures. The study found that laboratory accidents were the second sources of occupational infections as 70% of the infections were as a result of needle sticks, cuts from sharp medical equipment (60%), spills accounted for 27%, and splashes attributed to 25%.

Reports have shown that from laboratory acquired infections, bacterial infection accounted for 42.5% of reported infections (1669), viral infections accounted for 26.7% (1049), reckettsial infections accounted for 14.6% (573), fungal infection accounted for nine percent (353), chlamydial infection accounted for 3..3% (128), infection by parasites accounted for 2.9% (115) while unspecified infections accounted for 0.9% (34). The results also revealed that chlamydial infections attributed to the highest rate of mortality of 7.8% (Vidal, Paucod, Thibault, & Isoard,

1993). On the other hand, a study conducted in Turkey revealed that 91.3% of the respondents used glove and 87.4% put on laboratory coats (Elduma, 2012).

Further literature indicates needle-stick injuries occurred when conducting animal experiments at Biosafety Level Four Laboratory in Hamburg, the state of Germany, in the year 2009 (Günther *et al.*, 2011).

Hryhorczuk *et al*., (2004) noted that syringes that contained the Zaire ebolaviruses mixed with Freund adjuvant results to outbreak of Dengue virus-infection that was transmitted to laboratory scientist when conducting mosquito transmission and infection experiments. The exposure that was attributed to the laboratory-based experiments lead to acute transmission of Dengue Virus infections.

2.3.1.2 Chemical Hazards

Approximately thirty-two million workers are more likely to be exposed to chemical hazards. There are approximately 650,000 chemical products and hundreds of new chemical products are produced on annual basis (Bennett *et al.,* 2015). Henceforth, this tend to expose employers as well as their workers to chemical hazards. Exposure to these chemicals may result to serious health complication such as lung damage, heart diseases, kidney failure, rashes, cancer, central nervous system complication and burns. Other chemical hazards may pause safety risks since they are explosive and can cause fire and other fatal accidents (Fitzpatrick, 2004; Gestal, 1987; Pohanish, 2003).

Studies show that the general task of healthcare workers tend to use specific chemicals and procedures that subject them to occupational injuries, physical contact with infectious diseases and infected patient and eventually lead to death of some workers (Bennett *et al.,* 2015).

ISO 15189 documents states, that laboratories are supposed to be designed in manner that enhance operational efficiency, optimizes comforts of occupants, minimize occupational illness and risk, project both workers, visitors and patients from any potential hazard (Antonelli *et al.,* 2017).

In supplement with this Clinical Laboratory and Standardization Institute (CLSI) guideline states, "To meet governmental and accreditation requirements, 'the lab need to have well defined process of training to all staff on infection control, emergency preparedness, universal precautions, personal protective equipment, chemical and disposal of hazardous wastes (Verbrugge & Huisman, 2015).

A survey by Sewunet *et al.* (2014) on safety practices among hospital laboratories' reveals that in spite of the fact that there was the list of all chemicals in laboratories were recorded, not all chemicals were adequately labeled and it was difficult to know the person who was responsible for chemical labeling (Sewunet *et al.,* 2014). The study also established that some laboratory shelves contained expired chemicals and there was a delay in disposal of the expired chemical for a period of six months. Moreover, the study found that all the expired chemicals were disposed to incinerators without considering whether the chemicals are explosive, volatile or flammable. Further, the study found that sixty percent of the laboratories were unaware of disposal site for reagents, chemicals and leftovers. Furthermore, the study found out poor chemical handling with respect to disposal and storage posed occupational workers and community at large to chemical risk.

Health effects of chemical exposure data are not regularly inclusive. Two terms are often used interchangeably hazard and toxicity when discussing the health effects of chemicals (Pohanish Richard, 2003). When exposed to high-prolonged exposure or concentrations to some substances, olfactory fatigue may occur. While the danger of overexposure remains, this may cause the odor to seem to diminish or disappear. The throat, eye, and nose irritation, increased mucus production and headaches are the symptoms of over-exposure. Particularly many solvents, narcotic affects, including drowsiness, or collapse, dizziness, or confusion may result from exposure to various substances (Forsberg *et al.,* 2014; Gestal, 1987; Meyer, 1977).

2.3.1.3 Physical Hazards

According to Burton (2010) noted that the World Health Organization set provision for all medical laboratories to have at least minimum standards that should be fulfilled when disposing physical hazards depending on the laboratories' scope. The WHO report also indicates that all specimen- reception rooms and working areas ought to be segregated from the offices considering the specimen rooms as potential infectious area henceforth biohazard symbol should be put at the doors of these rooms. The report also indicate that the specimen-room floor ought to be impermeable to liquid and slip-resistant. The walls of the specimen rooms should be easy to clean, impervious and smooth. One of the rooms should be set aside for reception and treatment of disposable waste. In addition, the room should be well ventilated, receive adequate light and in case of an accident, mechanisms should be put in place to counteract such incidences. Practically, most of labs operations are phased with the challenge of limited pace and poor utilization of available space. This is due to the fact that much attention has focused on planning and designing of medical laboratory structures(Stave, 2016).

Nasim *et al.* (2010) conducted a research of the state of physical hazard in Pakistan. The study found out that 46.2% of laboratory technicians failed to use personal protective equipment, 39.5% of the participants were using recapped syringes on regular basis and 10.7% of the respondents recapped occasionally. The results also revealed that the Pakistan authorities suggested that all used syringes should be cut so as to prevent their reuse. However, thirty-six percent of the participants cut the used syringes before the dispose them into municipal dustbins. Moreover, the results revealed that 65.2% of participants indicated that there was no waste segregation mechanism for disposing sharp medical objects hence all the waste were thrown into municipal dustbins. Besides that, the study found that in spite of the fact mount pipetting poses physical hazard, thirty-eight percent of laboratory technicians were still using mount pipette. Further, the study established that 73.9% of medical laboratories failed to adhere to operation standards, 83.4% of accidents in the laboratories were not recorded and 85% of the participants were not trained on biosafety (Nasim *et al.*, 2010).

If occupational equipment and tasks do not consist of ergonomic values in their design; the workers may be exposed to unnecessary physical stress, overexertion, and strain, including Vibration, forceful exertions, awkward postures, heavy lifting, and repetitive motion (Stave, 2016). To be familiar with ergonomic hazard factors in the place of work is an important first step in correcting risks and thereby improving workers protection. It is believed that the reduction of physical stress in the workplaces (laboratories) could get rid of up to half of the grave injuries each year. Employers/ employees can be trained to foresee what might probably go wrong and modify tools and the working surroundings to make responsibilities safer for its workers (Nasim *et al.*, 2010).

2.4 Control measures applied by medical laboratory staff to mitigate the OSH hazards.

According to WHO report (2016), approximately, eighty percent of the entire waste generated by medical laboratories in developing nations are contaminated and infectious and disposal system in these institutions are disorganized. In the state of Ethiopia, 26.1% of medical laboratories disposed waste after decontamination; other medical laboratories did not put in place waste disposal system and they failed to adhere to waste disposal procedures (Burton, 2010).

According to Nasim *et al.* (2010), maintenance of good sanitation or hygienic conditions prevent biological risk at the area off work. Educative programs for workers with respect to personal –hygienic practices ought to emphasize on careful washing of hands as it extremely important in preventing diseases (Elduma, 2012). Moreover, workers are supposed to be informed on the essence of using personal protective equipment and removing them after working periods. There are numerous vaccines available for use in various states with some of the vaccines are strictly to be used for particular work groups. Laboratory training is important for workers' protection against occupational hazards. Guidelines and commentaries are offered on effective measures for controlling and preventing occupational infections or diseases transmission (Colligan & Cohen, 2004; Francis, 2013).

A study by Casanova *et al.* (2008) on microorganism transfer on health workers' PPEs revealed the most of laboratories workers are most vulnerable group for occupational hazards compared to other medical workers. The study also found that the laboratory workers are exposed to a wide variety of occupational health-hazards such as infectious materials, contact with infected body fluid of patients such as pus, secretion, blood and sputum or medical tools that are contaminated with agents within the laboratories environment (Casanova *et al.,* 2008; Forsberg *et al.*, 2014).

Moreover, individuals' attitudes or behavioral patterns toward safety programs have significant influence on involvement in laboratory accidents that may put themselves and other staff at risk. Individuals' behavior toward laboratory safety have significant effect on controlling and preventing infections. For instance, poor techniques or carelessness during handling materials that are infectious, infectious aerosols exposure, needle stings are the main causes of laboratory-acquired occupational infections. Taking care of patients with communicable infections tend to pose the health workers such as laboratorian to high health risk.

Laboratory personnel in various hospitals often encounter occupational hazards therefore their health –safety be jeopardized thus there is need for adequate preventive and protective mechanisms to be put in place. Biological safety in a discipline that promote safety procedures, practices and proper utilization of laboratory tools and facilities among laboratorians. Laboratory accidents are rampant due to the fact that most of workers do not have knowledge on proper laboratory measures, failure to implement safe-laboratory procedures and practices as well as indifferent attitude among workers in Pakistan (Aksoy *et al.,* 2008; Casanova *et al.*, 2008).

Training of laboratory personnel plays a key role in enhancing staff protection. Every employer ought to provide comprehensive training on controlling of infections so as to enable workers to identify and promptly report on any health risk. The most commonly used techniques to prevent infectious diseases among laboratory workers include: protection against direct or physical contact with contaminated biological material, implementation of effective post-exposure procedures and vaccinations.

Effective habits among workers play integral role in prevention of workplace infections (Colligan & Cohen, 2004; Hryhorczuk *et al.*, 2004; Nyakang'o, 2005).

According to Forsberg *et al.* (2014) development of practical instructions are aimed at improving workers' safety thus projecting occupational groups against any potentially harmful biological agents. Disease diagnostic laboratories tend to pose high health risk among laboratory workers. Hence, there is need for development of proper procedures that occupational safety against microbes, biological materials, through provision of safety training among laboratory workers to reduce or mitigate the risk. Development of appropriate work habits through training has significant effect in preventing laboratory-related infections (Colligan & Cohen, 2004).

To control laboratory hazards researchers should adhere to recommended biosafety practices when handling any live bacterial cultures, even attenuated strains, and public institutions should implement and maintain effective surveillance systems to detect and monitor unexpected acute illness in laboratory workers. In addition, bio-waste management should be supported through appropriate education, training, and commitment of health care staff, management, and health care managers within an effective policy and legislative framework (Hall, 2016; World Health Organization, 2004).

A review work done by Cohen (1977), on measures to control physical hazards recommends organizations to have systems in place for workers' safety and risk management. Another key control measure includes: establishing national guidelines to monitor and standardize occupational safety among health care workers so as to improve on overall safety of workers and patients (Casanova *et al.*, 2008). Review of documentations indicates that a few public agencies set provisions regarding empirical treatments of healthcare staff in case of their hospitalization (Benjamin, 2012; Cohen, 1977; World Health Organization, 2002). Assessing resistant patterns of pathogens in all hospitals necessitate the essence of such guidelines (Ramroop *et al.,* 2004).

Study done in Pakistan further indicates biosafety as an important issue in setting of laboratories in every nation, more so in developing nations (Nasim *et al.*, 2010). The review of the state of safety practices and occupational health in Africa took place in a global meeting in Benin. A report of several observations revealed that there are poor OSH review mechanisms in most of the African countries, some have OSH infrastructures but lack enforcement mechanisms or underutilize, and majority have inadequate OSH policy especially Ghana. Further, a study in Nigeria showed that the laboratories evaluated lacked adequate first aid facilities, no established incident reporting system and lack of a policy on how to handle spillages. In addition, the methods of waste disposal were inadequate and though the work surfaces were regularly, decontaminated sinks were used for both hand washing and waste disposal (Benjamin, 2012; Cohen, 1977; Fadeyi *et al.*, 2011; Nasim *et al.*, 2010).

The Directorate of Occupational Safety and Health Services (DOSHS) are responsible for OSH in Kenya. DOSHS is the nominated national authority for the investigation and analysis of occupational diseases and accidents, and dangerous occurrences as well as for maintenance and collection of a database (Nyakang'o, 2005).

Physical hazards can be curbed when employers appropriately design the job or work place and also selecting the appropriate tools or gear for that work in laboratories. Government or private employers of labor can establish measures to control occupational hazards by using: Suitable laboratory controls, such as work station, tool, and equipment design or redesign; Occupation practices, such as proper lifting procedures and keeping work surrounding clean; Administrative controls, such as more job variety and better rest breaks, and worker alternation if necessary; and Personal protecting equipment, such as vibration gloves, knee pads, and similar devices (GOK, 2007; Nyakang'o, 2005; Siegel *et al.,* 2007; Stave, 2016).

2.5 Factors that hinder implementation of good practice of OSH

There is need for health organizations to implement health and safety management systems so as to ensure continuous improvement. Most of organizations in health

sector have adopted management certification systems for health, quality and safety of health workers and patients in various parts of the world. To ensure effective designing on health and occupational safety health systems, health organizations are supposed to adhere to legal requirements, conduct risk assessments, implement safety operation procedures and train workers on occupational safety (Colligan & Cohen, 2004; O'Toole, 2002; Ramroop *et al.*, 2004).

Hayes *et al.*, (1998) proposed five distinct constructs for assessment of workplace safety and they include: the level of management commitment to workplace safety, safety practices by supervisors, job safety, initiation of safety programmes and coworkers' safety practices are some of the five critical issues that need to be taken into consideration when assessing workplace safety. According to Steenkamp and Van Schoor (2002), occupational health and safety ought to be top management leaders' priority since it is a complex international problem. Commitment level of management plays an integral role in occupational safety innervation (Steenkamp & Van Schoor, 2002). Yule *et al.* (2006) established that the perception of staff with respect to management occupational- safety action have significant effect on accident reduction.

Study conducted by Geldart *et al.* (2010) in relation to assessment occupational and health safety in manufacturing firms in Canada found that workers' attitude, administrative practices and policies have significant effect on workplace safety(Geldart *et al.,* 2010).

Hinze and Wilson (2000) established that occupational safety policies set clear guidelines for awareness creation among organizational staff and for improvement of overall occupational safety performance. Policy framing focuses on identification of scope of activities conducted with an organization and assessment of the level of top management commitment to integrate health and safety practices with organizational setting (Hinze & Wilson, 2000).

According to Yule *et al.* (2006) the study's findings conformed to occupational safety procedures and regulations when the actions of organizational supervisors are in congruent with the set occupational and health practices, standards and policies. Supervisory safety practices focus on the ability of supervisors to keep and tract records of unsafe practices and acknowledge workers who have adopted safe working practices (Yule *et al.,* 2006).

Safety practice among coworkers is also health and safety managerial element that can be used to enhance organizational safety performance (Ford & Tetrick, 2008). Coworker's safety is concerned with how organizational workers perceive and value health and safety of their workmates (Hayes *et al.,* 1998).

Ford and Tetrick (2008) noted that the behavior and personality of staff in their areas of work have significant effect on accident occurrence. Safety behavior are activities that are carried out by staff in their area of work so as to ensure safety of cowers, their personal safety and the overall safety of the organization. Ford and Tetrick (2008) established that safety behavior can be measured in terms of engagement actions that tend to promoted safety and the level of avoiding to carry out activities that decrease occupational safety.

Gile (2004) noted that it is prudent for organization to adopt safety culture. The safety culture is defined as the attitudes, competencies, perceptions, values, behavioral pattern, proficiency and style that influence health and safety management in organizational setting (World Health Organization, 2004). Effective safety culture in area of work result to reduction of workers' injuries thus leading to minimization of accident cost. Adoption of safety culture has significant effect on safety performance and this result to improvement in skill, knowledge and workers' productivity in their area of work. Knowledge is based on the ability to comprehend safety information, attitude focuses on the feeling of workers toward safety and behavior depicts staff, management and overall organization performance (Agwu, 2012; Hall, 2016).

It is paramount for all staff to be educated on safety training so as to improve safety awareness. Training on occupational safety is supposed to be a continuous process since it has positive influence on staff behavior (Johnston *et al.,* 1994). Management plays a key role in ensuring effective and efficient provision of safety program. Allocation of sufficient resources, promptly responding to safety complaints and suggestion, conducting regular safety meetings, workers training, regular assessment of workplace safety and implementation of comprehensive safety policies are some of the ways organizational management can improve on occupational safety(Shirouyehzad *et al.,* 2011).

2.6 Previous works relevant to study

With the above reviews of various literatures from diverse and seasoned scholars, it is therefore pertinent to assess the past studies undertaken in relations to occupational safety and health relating to medical laboratories. Seldom studies have been made available on medical laboratories in developing nations in spite of the fact that injury cases have been reported in these medical laboratories within developing countries without proper documentation (Al Hassani, 2011; Nkoko *et al.,* 2014).

Rechel & McKee (2014) made critical assessments on a various rstudies that were carried out in an attempt to build up occupational Safety and Health system as a general and formidable system. The central focal point of these studies dealt with: the necessity to set up occupational Safety and Health departments, the cost-effective benefits of maintaining and establishing department and occupational incidents (that is illness or injury) costs (Rechel & McKee, 2014). Furthermore it is important to note that studies linked to occupational Safety and Health has mainly dwelt on the hospital departments and not laboratories in particular (Benjamin, 2012; Fadeyi *et al.*, 2011; Manyele *et al.,* 2008; Nyakang'o, 2005). This and additional studies have identified the Safety and Health issues in healthcare, investigated on mitigation of hazard and preventive methods, economic benefit and the cost incurred during ill-health incidents (Colligan & Cohen, 2004; Johnston *et al.*, 1994).

Research findings from previous studies indicate that there is a strong body of existing proof which shows that health risks of employees were connected with pharmaceutical and health care costs. An emergent body of literature also authenticates that health risks are linked with the productivity measures of time away from work, absenteeism, workers' compensation. In addition, studies have also shown that changes in risks were associated with changes in health care costs, time 'away from work' (Barling, Kelloway, & Iverson, 2003; Fingerhut *et al.*, 2005; Manyele *et al.*, 2008; Nyakang'o, 2005).

In agreement with the above studies, Aksoy *et al.* (2008) furthermore asserts that in order for any medical laboratory to run efficiently and effectively, it is important that a successful safety program is implemented. This needs the full collaboration of all laboratory staff and in the long run reduces the general cases of hazards and cost in operations (Aksoy *et al.*, 2008).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Introduction

This section focused on discussing the manner in which the presented study was conducted. Specifically, the chapter focused on presentation of methods and instruments that were utilized to assess occupational health and safety status among the medical laboratories in Kajiado County.

3.2 Study design

The current study employed a cross- sectional research technique and it entailed administration of semi-structure questionnaire and interviewing of key-informants for a period of one month. Interviewing key respondents enabled the researcher to collect insightful information and descriptions (Polit & Beck, 2004).

3.3 Study area and population

The study was conducted at all health facilities with medical laboratories in Kajiado County, Kenya and which are licensed by Kenya Medical Laboratory and Technicians Board. Kajiado County has a total population of approximately 800,000 households covering an area of 21,902.9 Sq. kilometres. It has 118 licensed medical laboratories with 250 registered medical laboratory technicians and technologists. The laboratory workers in these laboratories work for more than 8 hours and in most cases, will get a lone worker in the laboratory due understaffing. The medical laboratories are normally located in the furthest corners of the facility, often next to the wash rooms, and are the smallest rooms with minimal ventilation and space.

3.4 Location of Study Area

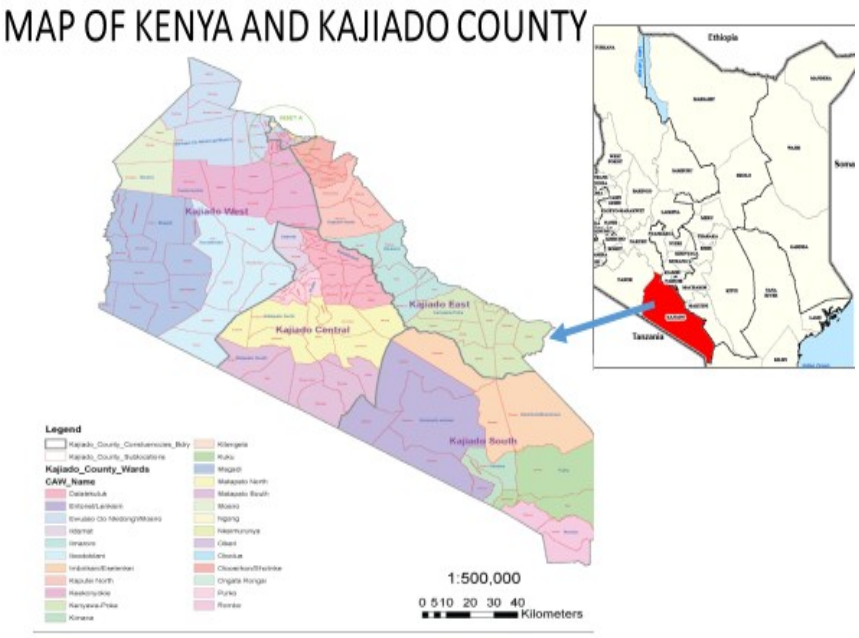

Figure 3. 1: Map of Kenya and Kajido County

Source: Survey of Kenya Maps (2012)

3.5 Sampling Method

The study used the entire population of 250 registered medical laboratory technicians and technologists and 118 licensed medical laboratories.

3.6 Sample size determination

Since the population of this study was small and accessible, all the individuals (medical laboratory technicians and technologists) in the study population were included in the study. Therefore, 250 consent forms and questionnaires were administered among the health workers. Out of the total, 214 (85.6%) were signed and returned by the respondents on time. Institutional consent was also sought among 118 health facilities with licensed medical laboratories. Of these, 108 (91.53%) duly signed copies of the consent were returned.

Table 3. 1: Distribution of the sample size

S/N	Public laboratories	Private laboratories	Total	Respondents targeted
1	18	100	118	250

3.7 Research instruments

Data was collected in three major ways, which include checklists (Observational), interview guide, and structured self-administered questionnaires for medical laboratory staff. The self-administered questionnaires were based on self-reporting and each respondent were assisted with trained researcher in case they needed help. The researcher sought for consent from all respondents before interviewing them. The researcher also explained the aim of conducting this study and them administered questionnaires among the respondents to fill. The researcher assured the participants that the responses they provided were handled with confidentiality.

The self-administered questionnaires consisted of 24 questions regarding demographic variables; biological, chemical and physical hazards variables; control measures variables; and variables to establish the factors that hinder good OSH practices in medical laboratories with combined close and open responses. The observation checklist had 15 variables to assess the status of OSH in medical laboratories.

Checklist was used to ensure the researcher properly takes into account the state of various equipment's and facilities in the various laboratories and also ensure that the central issues have not been ignored. Interview guide collected data through structured interviewing workplace resource personnel such a line managers, supervisors and senior management leaders.

3.8 Validity and Reliability of Research Instruments

3.8.1 Validity of the Instruments

Validity of data collection instrument of this study was determined through conducting face validity (subjective assessment of research item contents). The independent experts and research in the field of investigation at the university were consulted so as to validate data collection instrument through assessment on the extent in which they respond to research questions and met objectives of this study. The researcher considered their suggestions on improving validity of data collection tool.

3.8.2 Reliability of the Instruments

To improve of reliability of data collection tool, the researcher conducted a pilot test. The reliability of research instruments was determined by using a split-half technique. Every researcher was involved in data collection process so as to triangulation by teaming research approach. Besides that, triangulation was conducted and it entailed making comparisons of the present data to available literature on occupational health and safety (Mugenda & Mugenda, 2012; Mugenda, 2008; Mugenda, 1999).

The research instruments were piloted in the neighboring Naivasha Sub County. The pilot involved 10% of the targeted sample size (25 staff members who were randomly selected and 6 public and 6 private health facilities). The essence of carrying out a pilot test was to improve on precision, clarity and eliminate ambiguous questions of in data collection instrument.

3.8.3 Data Collection, Processing and Analysis

Prior to gathering of study's data, the researcher sought for permission from the Institute of Energy and Environmental Technology of JKUAT and from department of health services in Kajiado County. Moreover, the researcher sought for consent of all study's participants (Appendix 3). In addition, the researcher adhered to autonomy and confidentiality throughout the study process. The participants had the right to decline or voluntary participate in data collection process. They were further

assured that in case they did not wish to participate, they were not supposed to be subjected to any prejudice, danger, malice or harm.

The management of medical laboratories were highlighted on the rationale of conducting this research. After receiving data collection permit, the researcher administered questionnaires to all participants (medical laboratories worker within Kajiado County). The study also sought for management assistance. Follow up activities were conducted so as to encourage all respondents to fill their questionnaires. The respondents were given a period of 14 working data to fill the questions and where by the questionnaires were collected by the researcher. Questionnaire was used so as to save on time spent when collecting data. The researcher explained the purpose of conducting this study.

The collected data was entered into Epidata version 3.1 software, cleaned with Stata 13, and analyzed using quantitative data analysis approach in Social Sciences (SPSS-version 20). Quantitative approach involved descriptive analysis. Descriptive analysis entailed calculation of percentage and frequencies that was used for presentation of quantitative data in tables and figures. Data from the open ended questions was recoded in Stata 13 and analyzed quantitatively based on objectives where necessary. Content analysis was used to analyze qualitative data that was then presented in prose form.

On factors that hinder implementation of good practice of Occupational Safety and Health practices findings, Pearson's Product Moment Correlation Coefficient (PPMCC) analysis for the factors was conducted so as to assess the strength of relationship between elements under investigation (A. Mugenda & Mugenda, 2012).

The symbol for correlation coefficient is r and its value range from +1 to -1 (Mugenda, 1999). Positive values represent positive correlation while negative values represent negative correlation. In case the value is zero it depicts that the variables under investigation are perfectly independent. Moreover, in case the p value is less than the significance level of 0.05, it depicts a significant relationship

between elements under investigation (Saunders, 2011). The results of the study were presented in tables and figures (pie charts and bar graphs).

3.9 Ethical Considerations

The present study adhered to ethical issues so as enhance credibility of research. Firstly, the researcher acknowledge the ideas borrowed from other researchers and authors through referencing as a way of avoiding plagiarism. Secondly, the researcher administered questionnaires strictly to individuals who filled their consent forms. Individuals who were not willing to participate in the study were not forced either. Thirdly, the researcher ensured confidentiality of information that were provided during data collection since authorized personnel were allowed to access the data. Data that was collected was kept in a safe house and authorized individuals were allowed to access it so as a way of ensuring confidentiality. Further, every participant was requested not to indicate their name is data collection tool as a way of enhancing anonymity.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The chapter focused on presentation, interpretation and discussion of study's results. The results were presented in tables and figures 9bar graphs and pie charts).

4.2 Response rate

Out of the 250 questionnaires that were distributed, 204 were well filled and returned, 30 questionnaires had incomplete information which could have affected the results and hence were not used, while 16 were non-responded. This represented 82% response rate. According to Kothari (2009) a response rate above 75% is regarded as excellent for reporting making inferences. Henceforth, the response rate of the study was within acceptable limits. In addition, 118 laboratories were targeted with 108 participating in the research (response rate of 92%). According to Mugenda (2008), a response rate of 70% is regarded as very good, 60% is regared as good while 50% is considered adequate for making inferences.

4.3 Social demographic data

Most (51.5%) of the study's respondents were males, majority of them were in the age bracket of 19 to 30 years (60.3%) with a combined average of 30.1 years and std dv of± 7.1. The participants were mostly of Diploma level of education (78.43%) and close to one-half of them had 2-5 years of experience as shown in table 4.1 below:

Table 4. 1: Social demographic data

Characteristics	Frequency	Percentage
Age group (years)		
19-30 Years	123	60.3%
31-42 Years	66	32.4%
43 Years and above	15	7.4%
Sex		
Female	99	48.5%
Male	105	51.5%
Education Level		
Diploma	160	78.43%
Higher Diploma	21	10.29%
Degree	20	9.8%
Masters	3	1.47%
Years of Experience		
1 year and below	9	4.4%
2-5 years	102	50.0%
6-10 years	72	35.3%
11 years and above	21	10.3%

The findings indicated that the respondents profile comprised more males (51.5 %) than females (48.5 %). This study findings are not consistent with the outcomes of Ndejjo *et al.* (2015) on occupational health hazards among 200 respondents (medical laboratorians) who were working in eight major health facilities in kampala, Ugandawhose results indicated male respondents were 28.5% while female respondents were 71.5%. The study sought to determined occupational health hazards which healthcare staff are faced with as well as how to mitigate the hazards (Ndejjo *et al.*, 2015). This study focused more on specific category of health care workers hence the disparity.

This study findings on educational level of education were consistent with findings by Manyele *et al.* (2008) on status of occupational safety among health service providers in Tanzania which indicated that 54.4% of the respondents had certificate level while 26% had ordinary diploma education indicating majority did not have post graduate degree training (Manyele *et al.*, 2008).

This study further concurs with a study by Ejilemele and Ojulu, (2005) on knowledge, attitudes and practices of laboratory safety at University of Port Ha-court teaching hospital, Nigeria, in which the respondents mean age was 35.3 and SD was 8.8 representing a youthful representation (Ejilemele & Ojulu, 2005). This implied that most of the study participants were fit for providing reliable responses for drawing conclusions.

4.4 Hazards

In regard to the status of OHS medical laboratories in Kajiado County, the study found that 26 per cent of all the medical laboratories technologists and technicians had experienced accidents in their laboratories.

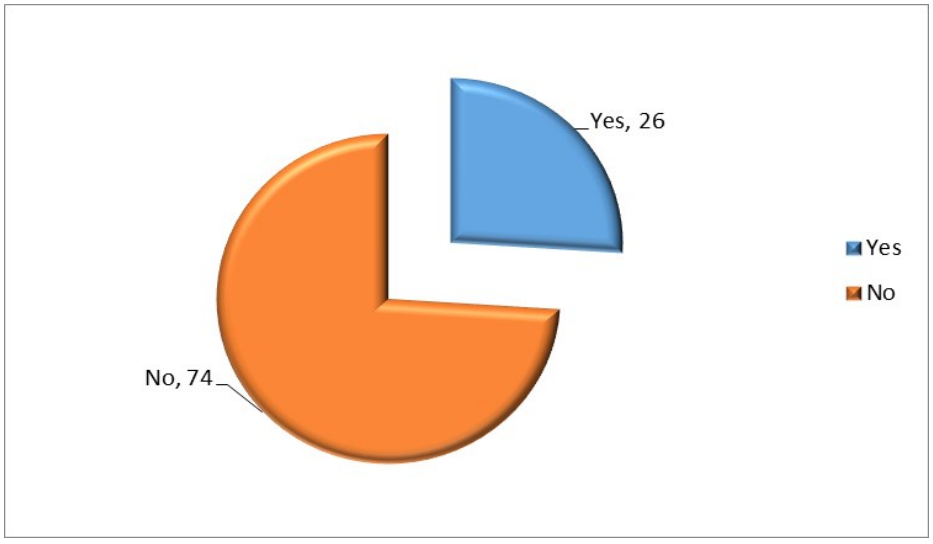

Figure 4. 1: Experience of Accidents in in Medical Maboratories

This study sought to establish the different hazards by health care workers working in medical laboratories in Kajiado County. The hazards were categorized into physical, chemical and biological.

4.4.1 Biological Hazards

This study identified biological hazards in Phlebotomy, specimen processing area, waiting bay and at the slide preparation areas. As shown in Table 4.2, 80% of the respondents reported exposure to bacteria, 47% exposure to parasites, 17% exposure to fungi, while only 8% reported exposure to viral vectors.

Table 4. 2: Exposure to Biological Hazards by medical laboratory staff

		Biological Hazard (n=204)			
Characteristic	Category	Bacteria n (%)	Parasite n (%)	Fungi n (%)	Viral n (%)
Overall	Total	164(80%)	95(47%)	35(17%)	17(8%)
Sex	Male	79(48%)	48 (51%)	20 (57%)	14(82%)
	Female	85 (52%)	47 (49%)	15 (43%)	3 (18%)
Education	Diploma	122 (74%)	72(76%)	29 (83%)	16 (94%)
	Higher Diploma	21(13%)	14 (15%)	4 (11%)	-
	Degree	19 (12%)	8 (8%)	1 (3%)	1 (6%)
	Masters	2 (1%)	1 (1%)	1 (3%)	-
Age	19-30 Years	92 (56%)	51 (54%)	22 (63%)	14 (82%)
	31-42 Years	59 (36%)	32 (34%)	9 (26%)	2 (12%)
	43 and above years	13 (8%)	12 (13%)	4 (11%)	1 (6%)
Years of experience	1 Year and below	9(5%)	5 (5%)	1(3%)	-
	2-5 years	75 (46%)	41 (43%)	20(57%)	11(65%)
	6-10 years	62 (38%)	40 (42%)	13(37%)	4(24%)
	11 years and above	18 (11%)	9 (9%)	1(3%)	2(12%)

Further analysis indicates that there were significant correlations between; age and exposure to bacteria ($r=-0.166$, $p<0.05$) and parasites (-0.157, $p<0.01$); education and exposure to bacteria ($r=0.160$, $p<0.05$); Years of experience had correlations with exposure to fungi ($r=-0.561$, $p<0.01$) and Viral vectors ($r=-0.342$, $p<0.01$).

In the current study, at least 65.6% of the respondents reported to have been exposed to at least one type of biological hazard. The high percentages for exposure to bacteria is attributable to the fact that most bacterial habitats surrounding humans are either in digestion systems as normal flora or present as infection. In addition, biological hazards in medical laboratory setting are present in body tissues, cadavers, body fluid and blood and infected workers (Ejilemele & Ojulu, 2005).

This study findings are comparable with those of Ndejjo *et al.* (2015) that focused on occupational health hazards in among health staff in the city of Kampala, Uganda whose findings indicated that most of participants reported having exposure to biological hazards (39.5%) as compared to 31.5% who experienced non-biological hazards and also that not wearing necessary PPEs (AOR = 2.34 (1.29– 4.64), *P*-value (0.006)<0.05) is an independent predictors for experiencing a biological hazard (Ndejjo *et al.,* 2015).

The study sought to examine the relationship between chemical hazards and education level. From the findings, there is a significant relationship between experience of bacteria related biological hazards and level of education ($\chi^2= 9.929$, df =3, $p<0.05$). In addition, there is no significant relationship between experience of bacteria related biological hazards and level of education ($\chi^2= 4.125$, df =3, $p >0.05$). Further, there is no significant relationship between experience of bacteria related biological hazards and level of education ($\chi^2= 2.790$, df =3, $p >0.05$). Also, there is no significant relationship between experience of bacteria related biological hazards and level of education ($\chi^2= 3.055$, df =3, $p >0.05$). This implies that the experience of biological hazards in medical laboratories in Kajiado County, except for bacteria related hazards, is not significantly related to education level.

Table 4. 3: Biological Hazards and Education Level

		Degree	Masters	Higher Diploma	Diploma	Total	Chi square
Bacteria	Yes	19(11.6%)	2(1.2%)	21(12.8%)	122(74.4%)	164(100.0%)	X^2=9.929
	No	1(2.5%)	1(2.5%)	0(0.0%)	38(95.0%)	40(100.0%)	df=3
							p-value=0.019
Parasites	Yes	8(8.4%)	1(1.1%)	14(14.7%)	75.8%	95(100.0%)	X^2=4.125
	No	12(11.0%)	2(1.8%)	7(6.4%)	88(80.7%)	109(100.0%)	df=3
							p-value=0.248
Fungi	Yes	1(2.9%)	1(2.9%)	4(11.4%)	29(82.9%)	35(100.0%)	X^2=2.790
	No	19(11.2%)	2(1.2%)	17(10.1%)	131(77.5%)	169(100.0%)	df=3
							p-value=0.425
Viral	Yes	1(5.9%)	0(0.0%)	0(0.0%)	16(94.1%)	17(100.0%)	X^2=3.055
	No	19(10.2%)	3(1.6%)	21(11.2%)	144(77.0%)	187(100.0%)	df=3
							p-value=0.383

4.4.2 Chemical Hazards

These study findings indicate that 38.24% of the respondents handled un-marked and un-labeled chemicals with only 15.2% exposed to flammable and combustible liquids, and flammable solids as shown in the Figure 2. Further analysis indicated that there was no significant relationship between demographic factors and exposure to chemical hazards ($p>0.05$).

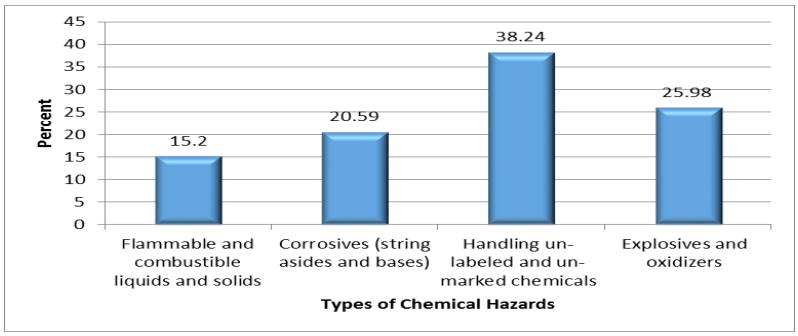

Figure 4. 2: Respondents exposure to chemical hazards

The study also sought to establish the relationship between experience of chemical hazards in medical laboratories in Kajiado County and education level. The findings indicated that there is no significant relationship between experience of explosives and oxidizers related hazards and level of education ($\chi 2$= 1.565, df =3, p>0.05). In addition, the findings indicated that there is no significant relationship between hazards related to handling un-labeled & un-marked chemicals and level of education ($\chi 2$= 0.289, df =3, p>0.05). Further, the results indicated that hazards related to corrosives (strong acids and bases) have no significant relationship with education level ($\chi 2$= 4.494, df =3, p>0.05). Similarly, the findings show that experience of hazards related to flammable and combustible liquids and solids is not significantly related to level of education of the medical laboratory technologists and technicians ($\chi 2$= 2.579, df =3, p>0.05).

Table 4. 4: Chemical hazards and Education Level

		Degree	Masters	Higher Diploma	Diploma	Total	Chi square
Explosives and oxidizers	Yes	4(7.5%)	0 (0.0%)	6(11.3%)	43(81.1%)	53(100.0%)	X^2=1.565 df=3 p-value=0.667
	No	16(10.6 %)	3(2.0%)	15(9.9%)	117(77.5 %)	151(100.0 %)	
Handling un-labeled & un-marked chemicals	Yes	8(10.3%)	1(1.3%)	7(9.0%)	62(79.5%)	78(100.0%)	X^2=0.289 df=3 p-value=0.962
	No	12(9.5%)	2(1.6%)	14(11.1 %)	98(77.8%)	126(100.0 %)	
Corrosives (strong acids and bases)	Yes	4(9.8%)	2(4.9%)	3(7.3%)	32(78.0%)	41(100.0%)	X^2=4.494 df=3 p-value=0.213
	No	16(9.8%)	1(0.6%)	18(11.0 %)	128(78.5 %)	163(100.0 %)	
Flammable & combustible liquids and solids	Yes	4(13.3%)	0(0.0%)	5(16.7%)	21(70.0%)	30(100.0%)	X^2=2.579 df=3 p-value=0.461
	No	16(9.3%)	3()1.7 %	16(9.3%)	137(79.7 %)	172(100.0 %)	

The study found out that 23% of respondents observed without Personal Protective Equipment (60% did not wear PPEs) reported having been exposed to Chemical hazards. In addition, the study found that not putting on PPEs was associated with vulnerability of chemical hazards (p=0.0067) posing a risk factor for the health workers.

All health facilities surveyed had different chemicals being used with 70% having chemical which were un-labelled, 61% had chemicals classified as either explosives, oxidizers or organic peroxides, 69% had corrosives, and 52% had flammable and

combustible liquids & solids. This implies that all the medical laboratories had chemical hazards.

Handling un-labelled or un-marked chemicals were the main chemical hazards affecting the workers of medical laboratories (38.24%) in this study. This study findings are comparable with those that focused on surveying safety practices in Oromia medical laboratories in Ethiopia that revealed that in spite of the fact that all chemicals in medical laboratories were labelled with respect to their chemical properties, it was difficult to assess who was labelled some chemicals (Sewunet *et al.*, 2014).

The respondents further indicated that there was an acute shortage of antiseptics in most of the health facilities and that supply of most laboratory chemicals was inconsistent. This was consistent with a study in Tanzania by Manyele *et al.* (2008) on the occupational- safety status among healthcare staff, that there was shortage of antiseptics due to inherent supply chain and procurement problems consequently leading to delay in drug supplies among public hospitals (Manyele *et al.*, 2008).

4.4.3 Physical Hazards

Generally, respondents indicated the major type of physical hazard was laboratory equipment's dangerously placed (49.51%) followed by ergonomics (32.35%) as shown in Figure 4.2 below:

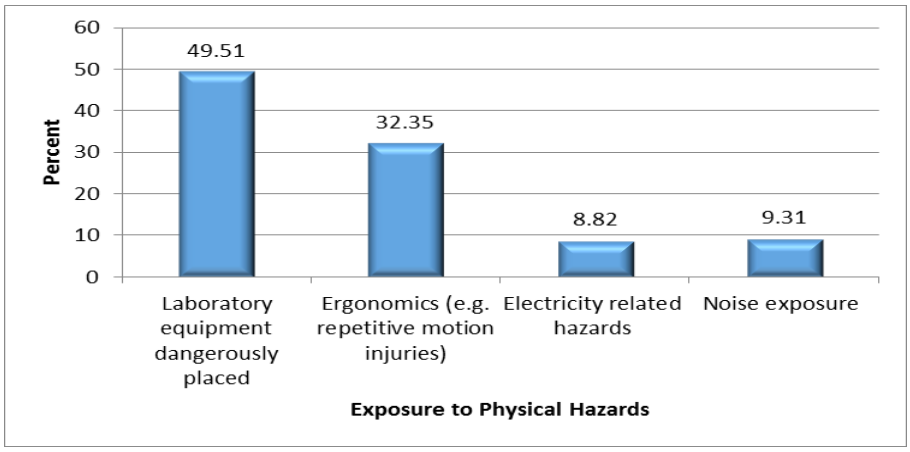

Figure 4. 3: Respondents exposure to physical hazards

The study sought to assess the relationship between exposure to physical hazards and level of education of the medical laboratories technologists and technicians. From the findings, the study found that there is no significant relationship between exposure to laboratory equipment dangerously placed and the level of education of medical laboratories technologists and technicians (χ^2= 2.579, df =3, p>0.05). The study also found that exposure to ergonomics (like repetitive motion injuries) was not significant associated with education level (χ^2= 2.579, df =3, p>0.05). Further, the study found that exposure to electricity related hazards was not significantly related to the education level of medical laboratories technologists and technicians (χ^2= 0.492, df =3, p>0.05). In addition, the study found that noise exposure was not significantly related to education level (χ^2= 0.492, df =3, p>0.05). This implies that exposure physical hazards was not significantly associated with education level of medical laboratories technologists and technicians.

Table 4. 5: Physical hazards and education level

		Degree	Masters	Higher Diploma	Diploma	Total	Chi square
Laboratory equipment dangerously placed	Yes	11 (10.9%)	2(2.0%)	12(11.9%)	76(75.2%)	101(100)	X^2=1.342
	No	9 (8.7%)	1(1.0%)	9(8.7%)	84(81.6%)	103(100.0%)	df=3 p-value=0.719
Ergonomics (e.g. repetitive motion injuries)	Yes	6(9.1%)	0(0.0%)	7(10.6%)	53(80.3%)	66(100.0%)	X^2=1.538
	No	14 (10.1%)	3(2.2%)	14(10.1%)	107(77.5%)	138(100.0%)	df=3 p-value=0.673
Electricity related hazards	Yes	2(12.5%)	0(0.0%)	2(12.5%)	12(75.0%)	16(100.0%)	X^2=0.492
	No	18(9.6%)	3(1.6%)	19(10.1%)	148(78.7%)	188(100.0%)	df=3 p-value=0.921
Noise exposure	Yes	1(5.6%)	1(5.6%)	0(0.0%)	16(88.9%)	18(100.0%)	X^2=4.911
	No	19(10.2%)	2(1.1%)	21(11.3%)	144(77.4%)	186(100.0%)	df=3 p-value=0.178

The study further found a weak negative correlation (r=-.043, p>0.05) between exposures to physical hazards with gender and a weak positive correlation (r=0.065, p>0.05) between level of education and the respondent being exposed to physical hazards. Health workers of 19-30 years had higher exposures on all forms of physical hazards reported on, though further analysis indicated a very weak correlation (r=-0.084, p>0.05) between age and exposure to physical hazards. Years of experience had a weak negative correlation (r=-0.013, p>0.05). These findings imply that gender, age, level of education and years of experience had a weak relationship with exposure to physical hazards. This finding was consistent with the finding on the study on gender differences in occupational exposure patterns (Ibe *et al.,* 2008).

The research grouped the physical hazards observed into Equipment related hazards, laboratory environment hazards, and Compressed Gases, and Pressure Related Hazards. From the findings, 57% of the laboratories had their workers exposed to electrical shocks by wearing rings, watches, and other jewelry when working around electrical appliances, while 51% of the laboratories had poor disposal mechanisms especially for broken glassware. Only 80% of the facilities were observed to have their electrical equipment connected to backup power cut-off. These findings imply that staff in majority of medical laboratories were exposed to physical hazard like cut from glasses and electric shock.

Plate 4. 1: Poor location of sputum mugs (which are placed on request forms)

Further, it was observed that 51% of the laboratories had their safe working pressure unmarked, 50% did not have fire extinguishers installed, and 42% had their gas cylinders not suitably located. Most laboratories (73% and 72% respectively) had warning restriction signs, secured pressurized gas cylinders, with 62% having no warning hazard signs and their pressure vessels periodically not examined respectively as shown in table 4.3.

Table 4. 6: Types of Equipment related Physical hazards (n=108)

No.	Type of Equipment related hazards	Number of Health facilities n=108	Percentage of health facilities
		n	%
1	Exposure to heat, steam, and pressure from autoclaves	37	34
2	Poor handling, loading, cleaning, and inspecting of rotors for the centrifuges	28	26
3	Health workers wearing rings, watches, and other jewellery when working around electrical appliances	62	57
4	Use of defective equipment's	41	38
5	Storing flammables in unapproved plastic containers	32	30
6	Poor disposal of broken glassware	57	53
7	Heating devices do not have backup power cut-off	22	20
8	Fire extinguishers not installed	54	50
9	Gas cylinders not suitably located	45	42
10	Safe working pressure not marked	55	51
11	Pressure vessels not periodically inspected	41	38

Plate 4. 2: Needles placed in basins as opposed to safety boxes

Findings indicate that all medical laboratories workers were exposed to prolonged use of a microscope due to lack of adjustable chairs and microscopes without affixed video cameras' which can cause problems with the neck and shoulders as well as eyestrain. The medical laboratory technicians were observed to use pipettes that are thumb-operated that can lead to soreness and eventual repetitive use injury instead of trigger operated and/or electric pipette pumps.

This study findings are comparable with those of Gestal on occupational hazards in hospitals indicating that 23% of human error accidents in the work place are electrical related and may lead directly to both external and internal burns, gaseous embolism, in form of asphyxia that is generated by electrical explosion of fire or injuries that victims suffered after collapse after electrocution (Gestal, 1987).

Further, as shown in table 5 below, 74% of the health facilities are exposing their health workers to prolonged standing at the laboratory benches instead of use of a stool that can be adjusted to a proper height, 48% of the laboratories with inadequate lighting, 94% of laboratories lacking hearing protective devices especially when

operating the centrifuges, and 56% of the laboratories having no restriction signs on bio-hazardous areas.

Table 4. 7: Types of laboratory environment-related hazards observed (n=108)

No.	Type of Laboratory environment-related hazards	Number of Health facilities n=108	Percentage of health facilities
		n	%
1	Workers exposed to prolonged standing at laboratory benches or hoods	80	74
2	Lack of an adjustable chair when viewing through a microscope	108	100
3	Microscopes without camera video affixed	108	100
4	Lighting not adequately illuminating all work areas	52	48
5	Lack of hearing protective devices (HPDs)	101	94
6	Lack of restriction signs for hazardous atmosphere or other serious safety work area	61	56
7	Use of pipettes that are thumb-operated plunger	108	100

Plate 4. 3: Example of laboratory design that has provided a knee space under the work top

Though nose masks and protective gloves were 100% provided in all the laboratories, only 47% of the laboratories were observed to have their health workers fully utilize nose masks and 58% use of protective gloves as personal protective equipment. These percentages are relatively high compared to a study conducted in Pakistan which revealed that 46.2% of lab-technicians were not using PPEs and the study conducted in Turkey revealed 91.3% and 87.45 of the respondents were using surgical gloves and lab coats (Aksoy *et al.*, 2008; Nasim *et al.*, 2010).

This study findings on laboratory equipment's dangerously placed are not in compliance with International Labour Organization recommendations that the processing of assessing occupational health and safety as well as worker's risk ought to be a conducted on regular basis (ILO, 2012).

4.5 Control Measures to Mitigate the OSH Hazards

The study sought to establish occupational measures in place to regulate health hazards and occupational safety. The research grouped control measures into the health facility measures, individual measures, and personal hand washing measures that were adopted so as to regulate health hazard and occupational safety as depicted in Table 4.8.

Table 4. 8: Control measures for Occupational safety and health at medical laboratories in Kajiado County

Occupational safety and health control measures	Frequency (N=204)	
	N	(%)
Medical facility has first aid box	75	36.8
Medical facility has proper waste disposal equipment	189	92.6
Provision of Antiseptics	21	10.3
Medical facility has chemical hoods	39	19.1
Medical facility has chemical hygiene plan	51	25.0
Health workers received HIV screening	177	87
Provided with post exposure prophylaxis	147	72
Provided with Hepatitis A vaccination	73	36
Provided with Hepatitis B vaccination	167	82
Provided with BCG vaccination	194	95
Provision of personal protective equipment's	122	60
Before and after laboratory procedures	155	76
After removing the gloves	112	55
After handling soiled materials	118	58
Before and after attending to patient/ clients	147	72
After handling of hazardous material and biological samples	126	62

According to the correlation findings in Table 4.9, the individual protective control measures had strong correlation with each other and that they are statistically significant at level 0.01. This means that the health workers received HIV screening, post exposure prophylaxis, Hepatitis A vaccination, Hepatitis B vaccination, personal protective equipment and used disinfectants. This implies that medical laboratories technologists are cognitive of taking necessary precautions for health and safety.

Table 4. 9: Individual protective measures correlations for medical laboratory staff working in Kajiado County, Kenya

		Health Workers Received HIV Screening	Provided with Post Exposure Prophylaxis	Provided with Hepatitis A Vaccination	Provided with Hepatitis B Vaccination	Provision of Personal Protective Equipment	Use of Disinfectants
Health Workers Received HIV Screening	Pearson Correlation	1	-0.018	0.020	-0.109	0.020	0.013
	Sig. (2-tailed)	-	0.803	0.777	0.122	0.771	0.856
	N	204	204	204	204	204	204
Provided with Post Exposure Prophylaxis	Pearson Correlation	-0.018	1	0.009	0.075	0.084	-0.016
	Sig. (2-tailed)	0.803	-	0.898	0.283	0.234	0.819
	N	204	204	204	204	204	204
Provided with Hepatitis A Vaccination	Pearson Correlation	0.020	0.009	1	-0.047	-0.069	0.808**
	Sig. (2-tailed)	0.777	0.898	-	0.507	0.329	0.000
	N	204	204	204	204	204	204
Provided With Hepatitis B Vaccination	Pearson Correlation	-0.109	0.075	-0.047	1	-0.040	-0.050
	Sig. (2-tailed)	0.122	0.283	0.507	-	0.565	0.479
	N	204	204	204	204	204	204
Provision of Personal Protective Equipment	Pearson Correlation	0.020	0.084	-0.069	-0.040	1	-0.044
	Sig. (2-tailed)	0.771	0.234	0.329	0.565	-	0.532
	N	204	204	204	204	204	204
Use of Disinfectants	Pearson Correlation	0.013	-0.016	0.808**	-0.050	-0.044	1
	Sig. (2-tailed)	0.856	0.819	0.000	0.479	0.532	-
	N	204	204	204	204	204	204

** Correlation is significant at the 0.01 level (2-tailed)

The study found that majority of the medical laboratory staff were using hygienic hand disinfection. From the findings, 87.7% were washing hands before and after every laboratory procedure, 82.8% were washing hands after handling soiled materials, 72.5% were washing hands after handling biomaterials and other hazardous materials, 67.2% were washing hands after removing the gloves and 45.6% were washing hands before and after handling patients.

Table 4. 10: Hygienic hand disinfection for medical laboratory staff

	Frequency		**Percent**	
	Yes	No	Yes	No
Before and after every laboratory procedure	179	25	87.7	12.3
After removing the gloves	137	67	67.2	32.8
After handling soiled materials	169	35	82.8	17.2
Before and after handling patients	93	111	45.6	54.4
After handling biomaterials and other hazardous materials	148	56	72.5	27.5

According to the correlation findings Table 4.11 below, the hand washing practices had strong correlation with each other and that they are statistically significant at level 0.05. These findings are largely similar to other previous studies conducted in low and middle income countries (Joshi *et al.,* 2013; Manyele *et al.*, 2008; Ndejjo *et al.*, 2015; Nsubuga & Jaakkola, 2005; Nyakang'o, 2005).

Table 4. 11: Hygienic hand disinfection correlations for medical laboratory staff working in medical laboratories, Kajiado County, Kenya

		Before and After Every Laboratory Procedure	After Removing the Gloves	After Handling Soiled Materials	Before and After Handling Patients	After Handling Biomaterials and Other Hazardous Materials
Before and After Every Laboratory Procedure	Pearson Correlation	1	-0.134	0.782**	-0.078	0.608**
	Sig. (2-Tailed)	-	0.056	0.000	0.267	0.000
	N	204	204	204	204	204
After Removing the Gloves	Pearson Correlation	-0.134	1	-0.097	-0.051	-0.103
	Sig. (2-Tailed)	0.056	-	0.169	0.465	0.144
	N	204	204	204	204	204
After Handling Soiled Materials	Pearson Correlation	0.782**	-0.097	1	-0.079	0.536**
	Sig. (2-Tailed)	0.000	0.169	-	0.259	0.000
	N	204	204	204	204	204
Before and After Handling Patients	Pearson Correlation	-0.078	-0.051	-0.079	1	-0.010
	Sig. (2-Tailed)	0.267	0.465	0.259	-	0.883
	N	204	204	204	204	204
After Handling Biomaterials and Other Hazardous Materials	Pearson Correlation	0.608**	-0.103	0.536**	-0.010	1
	Sig. (2-Tailed)	0.000	0.144	0.000	0.883	-
	N	204	204	204	204	204

**** Correlation is significant at the 0.01 level (2-tailed)**

The Centre for Disease Control has published guidelines for hand hygiene (World Health Organization, 2002). In case the hands of a person is dirty, contaminated with

proteinaceous material or blood, the CDC do recommends that it is prudent to wash the hands with soap and clean water. Moreover, the hands can be cleansed with alcohol-based agents in case the hands were not visibly soiled (Hassani, 2011).

In the current study, control mechanism provided by health facilities focused on supervision of occupational health and safety among staff and provision of training (98%), availing proper containers to dispose medical waste (92.6%) and first aid safety tools and equipment (36.8%). In addition, this study finding indicate that 25% and 19.1% of the facilities have chemical hygiene plans and chemical hoods respectively. This study findings further indicate that majority of laboratory workers had received HIV screening examination (87.0%) and 95.0% had received BCG vaccination. Regarding the hand washing practices, this study findings indicate that most laboratory staff washed their hands before and after every procedure (76%) and after handling soiled materials (58%). Seventy two per cent of laboratory workers washed hands before and after handling clients while only 62% after handling samples and other hazardous materials.

These study findings are similar to Siegel *et al.* (2007) findings that using all the necessary personal protective equipment was associated with reduced exposure to hazards. In addition Bolyard *et al.* (1998) report that most health facilities are provided with waste disposal facilities for the medical waste and apply simple measures like hand washing as control measures for occupational health hazards and further indicate that hand washing practices are not fully embraced in most health facilities. The proportion of health workers who reported washing hands after recommended procedures was lower than what had been reported by Ndejjo *et al.* (2015).

In the current study nearly 90% of the respondents reported that their employers had not provided antiseptics in the medical laboratories. This study findings are in line with Manyele *et al.* (2008) findings on status of occupational safety among health service providers in Tanzania, in which antiseptics were not equally available in the hospitals, due mainly to procurement problems and problems inherent in the supply chain for the drugs and other supplies in government hospitals (Manyele *et al.*,

2008). These findings are in compliance with ILO's recommendations for occupational health and safety that hand washing or antiseptic use after glove removal is a key requirement in undertaking laboratory procedures and infection control and also CDC recommendations that if hands are not visibly soiled, an alcohol-based waterless agent may be used for routinely decontaminating hands (CDC, 2013; Charles DB, 2014).

This study findings that 60% of the medical laboratories employees had not been provided with all the appropriate Personal Protective Equipment's by their employers were not in compliance with ILO's recommendations that provides that employers must assess tasks to identify potential worksite hazards and provide and ensure that workers use appropriate personal protective equipment (PPE) (CDC, 2013; O'Toole, 2002). This study findings are also supported by Hayden *et al.* (2008) who reported that use of PPEs reduced illnesses in hospital settings (Hayden, Blom, Lyle, Moore, & Weinstein, 2008). Other studies have reported that use and compliance with utilization of PPEs has for long been recognized as important infection control measure in the healthcare industry which should be emphasized to minimize exposure to occupational health hazards (Bolyard *et al.*, 1998; Siegel *et al.*, 2007).

4.6 Factors that hinder implementation of good OSH practices

The study sought to determine the factors that hinder implementation of good practice of Occupational Safety and Health practices whose findings are as shown in table 4.12.

Table 4.12: Factors hindering Occupational, Health and Safety practices at medical laboratories in Kajiado County

Factors Hindering OSH	Freq. (N=204)	Percentage (%)
Poor design of lab	81	39.7
Ignorance/lack of awareness	54	26.5
Lack of Personal Protective Equipment(s)	18	8.8
Inadequate resources/ infrastructure	84	41.2
Inadequate training on Occupational Health Safety	60	29.4
No policy on Occupational Health Safety	71	34.8
Negative attitude on Occupational Health Safety	96	47.1
Poor ergonomics	12	5.9

Pearson's Product Moment Correlation Coefficient (PPMCC) analysis for the factors was conducted: This was to examine the strength of the relationship between the variables (design of lab, ignorance level, lack of Personal Protective Equipment(s) PPEs, inadequate resources, inadequate Occupational Safety Health (OSH) training, lack of OSH policy, negative attitude, and poor ergonomics); by examining the extent the statistical significance of the relationship and the extent of the correlation coefficient as indicated in Table 4.13 below.

Table 4. 13: Correlation matrix of factors hindering OHS at Medical laboratories in Kajiado County

		design of lab	**Ignorance**	**PPEs**	**Resources**	**Training**	**Policy**	Attitude	Ergonomics
Poor design of lab	Pearson Correlation	1							
	Sig, (2 –tailed)								
	N	81							
Ignorance/lack of awareness	Pearson Correlation	0.724**	1						
	Sig, (2 –tailed)	0.000							
	N	54	54						
Lack of PPE(s)	Pearson Correlation	0.875**	0.721**	1					
	Sig, (2 –tailed)	0.000	0.000						
	N	18	18	18					
Inadequate resources/ infrastructure	Pearson Correlation	0.612**	0.861**	0.832**	1				
	Sig, (2 –tailed)	0.000	0.000	0.000					
	N	84	84	84	84				
Inadequate training on OHS	Pearson Correlation	0.812**	0.762**	0.839**	0.869**	1			
	Sig, (2 –tailed)	0.000	0.000	0.000	0.000				
	N	60	60	60	60	60			

No policy on OHS	Pearson Correlation	0.362**	0.422**	0.534**	.883**	0.896**	1		
	Sig, (2 –tailed)	0.000	0.000	0.000	0.000	0.000			
	N	71	71	71	71	71	71		
Negative attitude on OHS	Pearson Correlation	0.763**	0.761**	0.837**	0.684**	0.899**	0.842**	1	
	Sig, (2 –tailed)	0.000	0.000	0.000	0.000	0.000	0.000		
	N	96	96	96	96	96	96	96	
Poor ergonomics	Pearson Correlation	0.843**	0.867**	0.697**	0.569**	0.846**	0.814**	0.781**	1
	Sig, (2 –tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	N	12	12	12	12	12	12	12	12

**Correlation is significant at the 0.01 level (2-tailed)

The symbol for correlation coefficient is r and its value range from +1 to -1 (Mugenda, 1999). Positive values represent positive correlation while negative values represent negative correlation. In case the value is zero it depicts that the variables under investigation are perfectly independent. Moreover, in case the p value is less than the significance level of 0.05, it depicts a significant relationship between elements under investigation (Saunders, 2011).

From the regression summary results of the factors, R=0.727 (Predictors: (Constant), Poor Ergonomics, Inadequate Training, Lack PPE, Ignorance, Lab Design, No Policy, Negative Attitude, Inadequate Resources), the R Square is 0.651 i.e. 65.1% of the factors were identified in the study. The remaining 34.9% indicated that there are other factors which influenced implementation of good practice of Occupational Safety and Health practices in health facilities which were not identified in the study.

Coefficient analysis of all the factors indicated that training has the highest contribution to good practice of occupational safety and health practices with a unit increase of OSH training leading to increases in each of the other factors.

These study findings also indicate that training alone has the highest contribution to good practice of occupational safety and health practices with a unit increase of OSH training leading to increases in each of the other factors. Past empirical studies were apparently in agreement with these findings (Colligan & Cohen, 2004; Ejilemele & Ojulu, 2005; Ndejjo *et al.*, 2015; Nyakang'o, 2005; OSHA, 2002)

Our findings on training of staff on OSH are also comparable with those of a study that was carried out on the relationship between employees' perceptions of safety and organizational culture where insufficient safety training was the root cause of major accidents at the work place since employees did not have the knowledge and skills to identify potential hazards (Cooren, Kuhn, Cornelissen, & Clark, 2011; O'Toole, 2002). In a similar study, organizations which emphasized on safety through training and other managerial practices observed an increase in safety compliance among their employees (Ejilemele & Ojulu, 2005). Colligan and Cohen (2004) further reported that employees who have received safety training will likely

report less work-related injuries than their untrained counterparts (Colligan & Cohen, 2004). Other studies have further established that training allowed employees to acquire greater competencies to manage their work, leading to enhancement of their occupational safety (Barling *et al.*, 2003).

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

This section focused on presentation of summary of findings, recommendations and conclusions with respect to general and specific objectives of the study. The conclusions were drawn from the study's findings while recommendation were made from the conclusions.

5.1 Conclusions

The study concludes that at least one quarter of medical laboratories technologists and technicians had experienced accidents in their laboratories. This research also concludes that bacteria is the commonest (80%) type of bio-hazards, handling of un-marked or unlabeled chemicals (38.2%) is the commonest type of chemical hazards, and laboratory equipment' attributed to 49.5% of the commonest type of physical hazards at medical laboratories in Kajiado County.

The study also concludes that control measures among medical laboratory staff in Kajiado County include BCG vaccination (95%), proper waste disposal equipment in medical facilities (92.6%), HIV screening (87%), Hepatitis B vaccination (82%), hand washing practices, provision of post exposure prophylaxis (PEP) (72%) and use of personal protective equipment (PPE) (60%). However, less than half of the employees considered first aid box in the medical facilities (36.8%), Hepatitis A vaccination (36%), chemical hygiene plan in medical facilities (25.0%) and chemical hoods in medical facilities (19.1%) as control measures.

The study also concludes that factors that hinder implementation of good practices among medical laboratory staff in Kajiado County include negative attitude on occupational health safety (47.1%), inadequate resources/ infrastructure (41.2%), Poor design of lab (39.7%), lack of policy on occupational health safety in the facilities (34.8%), inadequate training on occupational health safety (29.4%), ignorance/lack of awareness (26.5%), lack of personal protective equipment(s) (8.8%) and poor ergonomics (5.9%).

5.2 Recommendations

The study recommends that occupational health and safety guidelines be developed and effectively communicated to all stakeholders to guide individuals in hazard management in medical laboratories.

The study recommends that the management of medical laboratories in Kajiado County should develop internal safety and health policies to guide in the management of biological, chemical and physical hazards.

To improve on OSH awareness the study recommends that all medical laboratory staff should be trained on OSH as stipulated by the OSHA (2007) regulations. The training should also cover importance of screening and vaccinations, use of PPE, use of PEP among other practices as control measures for hazards in the laboratories. This will increase OSH awareness among health staff, improve on participation of workers in health and safety, reduce morbidity, improve on staff productivity and upscaling of OSH practices. Employers should strengthen institutional protective measures like effective engineering and work place controls while encouraging individual protective measures to minimize exposure to hazards.

The study further recommends that the management of medical laboratories should provide adequate resources/ infrastructure to enable the implementation of good practices among medical laboratory staff. Also, the management should provide personal protective equipment(s) and proper ergonomics for utilization in laboratories.

5.3 Areas for Further Research

Further studies should be carried out to identify other factors hindering implementation of OSH practices in medical laboratories in Kajiado County and other parts of the Country. In addition, since this study was limited to Kajiado County, other comparative studies should be conducted in other Counties in Kenya to compare occupational safety and health status in different Counties. In addition,

further studies should be conducted on occupational safety and health status in medical laboratories in Kajiado County, Kenya.

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APPENDICES

Appendix 1: Questionnaire for Staff Members

I am a masters' student at Institute of Energy and Environment of JKUAT, pursuing a Master of Science degree in Occupational Safety and Health. I am requesting for your participation in answering the provided questions regarding occupational health and safety status among medical laboratories within Kajiado County. Information provided during this study will be considered as confidential and anonymous and will not be disclosed to anyone else. Please fill free and provide precise information as much as you can.

Instructions

1. Please provide precise information to your level best

2. Please do not indicate your name in the provided questionnaire

3. Confidentiality will be adhered to when handling the provided informantion

Thank you.

Section I: Background Information

1. Sex of person being interviewed *please Tick one*

Male □ Female □

2. Age Bracket

18 Years and below □ 19-30 years □

31-42 Years □ 43 Years and above □

3. Highest Education Level

Primary □ Secondary □ Degree □

Any other specify, _____

4. Working Experience

1 year and below □ 2-5 years □

6-10 years □ 11 years and above □

Section II: Biological, chemical and physical hazards that medical laboratory workers are exposed to.

5. What are the prevalent Biological hazards experienced in your Medical laboratory?

a. Bacteria Yes □ No □
b. Parasites Yes □ No □
c. Fungi Yes □ No □
d. Viral vector Yes □ No □

6. What are the physical hazards commonly experienced?

a. Noise exposure(e.g. centrifuges) Yes □ No □
b. Laboratory equipment's dangerously placed Yes □ No □

b(i). Which are some of the type of Equipment related hazards do you experience in your laboratory?

……

……..

c. Electricity related hazard's (e.g. from unrepaired electrical, exposed wires, overloaded sockets etc.) Yes □ No □
d. Ergonomic (e.g. repetitive motion, injuries etc.) Yes □ No □

7. What are the chemical hazards commonly experienced?

a. Corrosives (e.g. from Acids, bases etc.)….. Yes □ No □

b. Explosives e.g. picric acid ……Yes □ No □

c. Flammable & combustible liquids & solids(are they stored in a flammable vented cabinet)

Yes □ No □

d. Handling unmarked and unlabeled chemicals…. Yes □ No □

Section III: Control measures applied by medical laboratory staff to mitigate the OSH hazards.

8 Does your Medical Laboratory have a first-aid kit in case of accidents?.....Yes□ No□

9. Are you provided with Personal protective equipment's?..... Yes□ No□

10. Does your laboratory have a Chemical hygiene plan?..... Yes□ No□

11. Does your laboratory have biological safety cabinets & chemical hoods?.....Yes □ No□

12. Does your laboratory have proper segregation & waste disposal equipment's?....Yes□ No□

13. Are you provided with antiseptics?.....Yes □ No □

14. Have you ever received HIV screening?……Yes □ No □

15. In case of exposure to HIV, are you provided with post exposure prophylaxis...?Yes□ No □

16. Are you immunized against the following diseases?

(i)Hepatitis A…. Yes □ No □

(ii)Hepatitis B… Yes □ No □

. (iii)Tuberculosis…. Yes □ No □

17. How often do you wash your hands while at work in the laboratory?

(i)Before and after laboratory procedures… ……Yes □ No □

(ii)After removing the gloves……Yes □ No □

(iii)After handling soiled materials……Yes □ No □

v) Before and after handling clients/ each patient… ……Yes □ No □

(v)After handling biological samples and other hazardous materials Yes□ No □

Section IV: Factors that hinder implementation of good practice in Occupational Safety and Health practices.

18. Specify the Factor(s) that hinder Occupational Safety and Health practices in your Medical Laboratory?

(i) Poor design of the laboratory……Yes □ No □

(ii) ignorance/lack of awareness… …… Yes □ No □

(iii)Lack of personal protective equipment's… ……Yes □ No □

(iv) Inadequate resources/infrastructure… …….. ……Yes □ No □

(v) Inadequate training in occupational health and safety…….. Yes □ No □

(vi) No policy on occupational health and safety……. Yes □ No □

(vii) Negative attitude on Occupational Health Safety……. Yes □ No □

(viii)Poor ergonomics… ……...Yes □ No □

Thank you for your cooperation

Appendix II: Research Checklist

	GENERAL LABORATORY SAFETY	YES	NO
1	Workers exposed to prolonged standing at lab benches or hoods?		
2	Presence of adjustable chairs when viewing through microscopes?		
3	Microscopes have cameras videos affixed?		
4	Adequate light illuminating all work areas?		
5	Workers not wearing hearing protective devices?		
6	Use of pipettes that are thumb operated?		
7	Restriction signs for hazardous atmosphere or other serious safety work area present?		
8	Are Chemicals clearly labelled, including hazard symbols?		
9	Storing flammables in unapproved plastic containers?		
10	Heating devices do not have backup power cut-off?		
111	Fire extinguishers not installed		
12	Workers being exposed to heat, steam and pressure from autoclaves?		

13	Workers handling, loading, cleaning and inspecting centrifuges and rotors.
14	Workers wearing rings, watches & other jewelry when working?
15	Is the safe working pressure clearly marked on all pressure vessels?
16	Are all pressurized gas cylinders properly secured by restraining chains, bench clamps or similar?
17	Presence of defective equipment's?
18	Pressure vessels periodically inspected and serviced?

Appendix III: Informed Consent

OCCUPATIONAL SAFETY AND HEALTH STATUS IN MEDICAL LABORATORIES IN KAJIADO COUNTY, KENYA

The Purpose

I am Fridah Ntinyari Tait, a Masters student at JKUAT pursuing a degree of Masters of Science in Occupational Safety and Health. The purpose of the study is to establish the occupational safety and health status of medical laboratories in Kajiado County. The study specifically seeks to determine biological, chemical and physical hazards among medical laboratory staff in Kajiado County; establish control measures among medical laboratory staff in Kajiado County; determine factors that hinder implementation of good practices among medical laboratory staff in Kajiado County.

Procedures

Participation in this study will be required to answer questions on occupational health and safety status among medical laboratories within Kajiado County. You will be given one questionnaire to fill to the best of your knowledge. You may ask questions related to the study at any time. You can refuse to respond to any question without facing any consequences.

Discomforts and risks

There will be minimal risk for your involvement in this research. In addition, the questions you will be asked are not in sensitive nature and may not make you uncomfortable. However, if this happens you may refuse to answer if you so choose. The filling of the questionnaire will take approximately 15 minutes of your time.

Benefits

There may be no direct compensation or benefit for participants, nonetheless, information that will be used various stakeholders and administrators to adopt

strategies that can improve occupational health and safety status among medical laboratories in Kajiado County.

Voluntary Participation and Withdrawal

Your involvement in the present study is voluntary and in case you change your mind, you are permitted to opt out. No penalty will be charge to any participant who will fail to answer all questions.

Confidentiality

The research will ensure anonymity and confidentiality of all participants who will be involved in this study. Any information that will be provided will be used for academic purposes. Information that will be provided during the study will be stored in a locked cabinet and password will be set for any electronic information.

Contact information

In case of any inquiry regarding the research please contact me, Fridah Ntinyari Tait mobile number 0722354787. In addition, if you have any questions on your rights as a research participant you can contact my supervisors: Mr. Charles Mburu, Prof. Joseph Gikunju or Jomo Kenyatta University of Agriculture and Technology research review committee. Since you are now informed about this research and clearly understood what it will entail, I do ask you to provide participation consent or not to participate in the study.

Participant signature…….

Date……

Researcher's signature……

Date……

Appendix IV: List of Registered Public and Private Medical Laboratories

	Kajiado Central - Private/Fbo Labs	Service Delivery Tier	Number of Staffs
1	Border Medicare Centre	TIER 2	1
2	Kitengela Medical Services-Kajiado	TIER 3	2
3	Im-Hotep Medical Centre	TIER 2	1
4	Isra Wal Miraj Medical And Laboratory Services	TIER 2	1
5	Kajiado Shalom Community Hospital-Kajiado Branch	TIER 3	1
6	Aic Kajiado Dispensary	TIER 2	1
7	Ack Health For All Clinic	TIER 2	2
8	Isra Wal Miraj-Bissel Branch	TIER 2	1
9	Arami Health Services	TIER 2	1
10	Namayiana Medical Services	TIER 2	1
11	Alpha Medical Clinic	TIER 2	1
12	St. Raphael Laboratory	TIER 2	1
13	Uzima Medical Clinic	TIER 2	1
14	Jamii Medical Clinic Namanga	TIER 2	1
15	Border Medical Care-Namanga	TIER 2	1
16	Namanga Drug House	TIER 2	1
17	Manna Medical Clinic	TIER 2	1
18	8th Street Laboratories - Namanga	TIER 2	1
19	Grace Medical Centre - Namanga	TIER 2	1
20	Laanoi Medical Centre (Maasai Med. Centre) - Bissil	TIER 2	1
21	Neema Ent. Medical Clinic (Prudent Medical Clinic)	TIER 2	1
22	Olive Medical Services	TIER 2	1
23	Batian Medical Centre.	TIER 3	1
24	Leo Surgery	TIER 3	1
25	Lexa Medical Clinic	Tier 2	1
26	Aic Orinie Orinie - Fbo	Tier 2	1
27	Galaxy Hospital Kajiado Town	Tier 2	1

	Kajiado East Private/ Fbo Labs		
1	Kitengela Pona Services	TIER 3	1
2	Kitengela Medical Services -Kitengela	TIER 3	3
3	Gethrudes Childrens Hospital, Kitengela	TIER 3	2
4	St Pauls Hospital	TIER 3	2
5	St Theresa Dispensary - Fbo	TIER 2	1
6	Aga Khan Hospital	TIER 4	3
7	Meridian Medical Centre, Kitengela	TIER 3	2
8	Tocare Nursing Home	TIER 2	1
9	Sinai Hospital, Kitengela	TIER 3	2
10	Miliki Afya Limited	TIER 2	1
11	Sucos Hospital	TIER 2	1
12	Urafiki Medical Centre	TIER 2	2
13	Nairobi Womens Hospital, Kitengela	TIER 3	2
14	Mariakani Cottage Hospital - Kitengela	TIER 3	3
15	Kenyatta National Hospital - Parastatal - Kitengela	Tier 4	2
16	Ralph Hospital	Tier 3	2
17	Loving Care Clinic	Tier 2	1
	Kajiado West Private /Fbo Labs		
1	Fr. Andriano Boneati H/C	Tier 2	1
2	Magadi Hospital	Tier 2	1
	Loitokotok Private/Fbo Labs		
1	Lenkisem Fbo	TIER 2	1
2	Rombo Health Centre - Fbo	TIER 2	1
3	Osiligi Medical Clinic	TIER 2	1
4	Mureshi Community Hospital- Emali-Ltk Road Cbo	TIER 2	1
5	Oltukai Clinic	TIER 2	1
6	Tropical Medical Clinic	TIER 2	1
	Ministry Of Health (Moh) Labs (Total = 18)		
	Kajiado Central		
1	Kajiado District Hospital	TIER 3	7
2	Namanga Health Centre	TIER 2	2

3	Bissil Health Centre	TIER 2	1
	Kajiado North		
1	Ngong Sub County Hospital	TIER 3	3
2	Ongata Rongai Health Centre	TIER 2	3
	Kajiado East		
1	Kitengela Sub County Hospital	TIER 3	3
2	Masimba H/C	TIER 2	1
3	Isinya Health Centre	TIER 2	1
4	Mashuru Health Centre	TIER 2	1
5	Gk Prison Arthi River	TIER 2	1
	Kajiado West		
1	Entasopia Health Centre	Tier 2	2
2	Mile 46 Health Centre	Tier 2	1
3	Gsu Dispensary	Tier 2	1
	Kajiado South - Loitokotok		
1	Loitoktok Sub County Hospital	TIER 3	7
2	Kimana H/C	TIER 2	2
3	Imurtot H/C	TIER 2	1
4	Entarara Health Centre	TIER 2	1
5	Iltilal Health Centre	TIER 2	1
6	Namelok Health Centre	TIER 2	1
	Kajiado North Sub County Private and Fbos		
1	Mawepi Medical & Hiv/Aids Rehabilitation Community Centre	TIER 2	1
2	Kingsland Medical Clinic	TIER 2	1
3	Batian Medical Centre	TIER 2	1
4	Penda Medical Clinic	TIER 2	1
5	Dr Thuo Medical Clinic	TIER 2	1
6	Airtech Medical Centre	TIER 2	1
7	Edcar Medical Clinic	TIER 2	1
8	Santa Maria Medical Clnic	TIER 2	1
9	Matasia Nursing Home	TIER 2	1

10	Nasaroni Medical Clinic	TIER 2	1
11	Siloam Medical Clinic	TIER 2	1
12	Helmo Clinic& Lab Services	TIER 2	1
13	Zam Zam Medical Clinic	TIER 2	1
14	Enkiton Joy Nursing Home	TIER 2	1
15	Moka Medical Clinic	TIER 2	1
16	Maa Outpatient Centre	TIER 2	1
17	Kiserian Referal Lab	TIER 2	1
18	St Peters Health Clinic	TIER 2	1
19	Rosana Medical Clinic	TIER 2	1
20	St Cate Medical Clinic	TIER 2	1
21	Ongata Medical Clinic	TIER 2	1
22	Mariakani Cottage Hospital - Rongai	TIER 3	3
23	Rongai Diagnostic Labaratory	TIER 2	1
24	St Theresa Dispensary - Fbo	TIER 2	2
25	Embulbul Catholic Dispensary	TIER 2	2
26	St Marys Health Centre Kiserian	TIER 2	2
27	Clayhill Hospital	TIER 2	1
28	Garlands Medical Centre	TIER 2	1
29	Wananchi Jamii Nursing Home	TIER 2	1
30	Beacon Of Hope Health Cenre	TIER 2	2
31	Hope Nursing And Maternity Hospital	TIER 2	1
32	Wama Nursing Home	TIER 2	1
33	Fatima Maternity - Fbo	TIER 2	1
34	Avenue Healthcare	TIER 2	1
35	Sinai Hospital, Rongai	TIER 3	1
36	Gethrudes Hospital - Rongai	TIER 3	2
37	Meridian Medical Centre Rongai	TIER 3	2
38	Nairobi Womens Hospital, - Rongai	TIER 3	2
39	Ongata Comprehensive Medical Centre	TIER 3	2
40	Kenyatta National Hospital - Parastatal - Rongai	Tier 4	2
41	Aga Khan Hospital - Ngong	Tier 4	2

42	Pcea Symrna Med Clinic	TIER 2	1
43	Kkit Nursing Home	TIER 2	1
44	Vicordec Med Clinic	TIER 2	1
45	Drop Inn Rays Clinic	TIER 2	2
46	St Gladys Nursing Home	TIER 2	2