Chapter One

Introduction

1.1 Background of Study

A means of preventing accidents or minimizing potential personal injury or property damage is known as safety [1] and The World Health Organization (WHO) defines health as the whole condition of physical, mental, and social well-being, not just the absence of sickness or disability [2].

Best practices for safety and health define actions that are necessary to promote safe working conditions and reduce biological risks. Because of the risks involved in handling potentially contagious and toxic chemicals, health and safety are top priorities in any medical laboratory, and stringent regulations must be put in place to ensure compliance [1]. Medical laboratory technicians are especially vulnerable because they frequently handle biological samples that are contaminated with unknown pathogenic diseases [3].

Medical Laboratory Practitioners are a unique group of health professionals who operate in laboratories. They are Health Care Workers (HCWs) members. Medical professionals receive the results of laboratory analyses and utilize them to monitor and prevent disease, as well as to diagnose and treat patients [3]. These individuals in the healthcare industry are more susceptible to exposure risks at work, including those posed by infectious materials and contaminated wastes, various body fluids, radiation, toxic and flammable chemicals, biological agents, aerosols, sharps, wounds, mechanical and electrical hazards, and musculoskeletal stresses.

It is very important for human and economic growth, particularly in the healthcare industry, to increase knowledge and understanding of workplace hazards, such as how to detect risks, report problems, remove risks, and adhere to practical safety measures [4,5]. Which results in a safer working environment with a reduced chance of accidents and infections when present and known. Determining the level of health and safety knowledge that Medical Laboratory Practitioners possess and how it affects the performance of their duty is the specific goal of this study, which aims to evaluate the adherence to safety and healthy practices among Medical Laboratory practitioners in Oyo State.

1.2 Statement of the Problem

A biological specimen may be home to biological agents like bacteria, fungus, viruses, or parasites. Medical laboratory professionals handle and test human samples largely for the aim of providing results and interpretation for individualized patient treatment, infection prevention, and public health objectives [6].

Due to the numerous risks and hazards associated with completing these tests, including infectious aerosols, spills, broken glasses, cuts from sharp items, needle sticks, chemical agents, and others, laboratory employees frequently contract various diseases [7,8]. Infections spread most frequently through ingestion, such as through smoking, eating, or unintentional aspiration through a pipette, as well as through inhalation (particularly by aerosols), percutaneous inoculation (needle stick injuries, broken glass injuries, and/or animal bites or scratches), direct contact between contaminated surfaces (gloves, hands), and mucous membranes. The most common types of risks in medical laboratories, according to studies done in Nigeria, are bacteria (80% for biological risks), handling unlabeled chemicals (38.2% for chemical risks), laboratory equipment that isn't regularly maintained (49.5%) for physical risks, and not wearing personal protective equipment (PPE) was statistically associated with exposure to risks [9, 10, 11], and according to the Centers for Disease Control and Prevention (CDC), general rules for conducting business in a laboratory handling biological materials must be strictly followed with regular evaluation to spot deviations and areas of weakness. Infections and laboratory accidents are frequently reported in medical laboratories [12].

Additionally, if the incidence is this high in medical laboratories, it indicates that laboratory practitioners do not adhere to best practices, which is dangerous for the safety of all laboratory employees [12, 13].

In order to ensure that Medical Laboratory Practitioners in Oyo State are securely carrying out their tasks with a low risk of infection, it is crucial to evaluate the level of compliance to health and safety measures among them. This will inspire some evidence-based suggestions to the body.

1.3 Justification of the Study

In any medical laboratory, health and safety are top priorities due to the hazards involved in handling dangerous and infectious materials [1,4]. Medical laboratory practitioners should adopt safety and health practices thoroughly and have their compliance checked.

According to earlier studies, there is a lack of appropriate safety equipment in numerous laboratories and an improper use of good laboratory practices. However, this differs significantly between laboratories [1,4]. The understanding of each employee and the employer regarding safety and health procedures in the laboratory should inspire the right practice minimizing the impact of physical, chemical, and biological dangers among medical laboratory professionals.

It will be easier to stay current on operational flaws and disparities in the knowledge and practice of Medical Laboratory Practitioners if you have a thorough understanding of the level of adherence to health and safety practices. As a result, the risk of infection from biological risks will be reduced, and maximum safety will be maintained.

1.4 Objectives

1.4.1 General Objective

The main objective of this study is to determine the Safety and Healthy practices among the Medical laboratory practitioners in Oyo State.

1.4.2 Specific Objective

1. To assess the knowledge of laboratory practitioners on standard laboratory safety and health measures.

2. To assess the adherence of Medical Laboratory Practitioners to Good Safety and Healthy Practices.
3. To determine the correlations between the knowledge, adherence and socio-demographic characteristics of Medical Laboratory Practitioners on Safety and Healthy Practices.

1.5 Research Questions

The research will be guided by the following research questions.

1. What is the level of knowledge of Medical Laboratory Practitioners on Health and Safety Practices in the Laboratory?

2. What are the levels of Adherence of Medical Laboratory Practitioners to Good Safety and Healthy Practices?

3. What are the correlations between the knowledge, adherence and socio-demographic characteristics of Medical Laboratory Practitioners to Good Safety and Healthy Practices?

1.6 Statement of Hypotheses

At a 0.05 level of significance, the study will formulate and test the following hypotheses:

i. Null Hypothesis Ho: There is no significant statistical association between the knowledge of Medical Laboratory Practitioners and their practices in the laboratory in Oyo State.

ii. Null Hypothesis H_0: Medical Laboratory Practitioners in Oyo State do not adhere strictly to the standard safety and healthy guideline.

iii. Alternate Hypothesis H_1: In Oyo State, there is a statistically significant correlation between medical laboratory practitioners' expertise and their laboratory practices.

iv. Alternate Hypothesis H_1: Medical Laboratory Practitioners in Oyo State adhere strictly to the standard safety and healthy guideline.

1.7 Significance of the Study

1. The study will provide information on the present knowledge of Health and Safety Practices in the Laboratory among Medical Laboratory Practitioners in Ibadan South West Local Government, Oyo State.

2. The study will guide Medical Laboratory Practitioners on adhering to Good Safety and Healthy Practices.

3. Data generated from the study will be used to provide recommendation to the scientific knowledge of Health and Safety Practices in the Laboratory among Medical Laboratory Practitioners.

1.8 Scope of the Study

This research aims to determine the Safety and Healthy practices among the Medical laboratory practitioners in Ibadan, Oyo State. This research is restricted to one selected Local Government Area, in Ibadan.

1.9 Limitation of the Study

This study is limited by its small geographical area and moderate sample size.

1.10 Operational Definition of Terms

- **Safety:** A means of preventing accidents or minimizing potential personal injury or property damage is known as safety [1]. Safety was also described by the International Organization for Standardization as a planned program procedure with a requirement for routine audit and review [14].
- **Health:** WHO defines health as the fullest possible condition of physical, mental, and social well-being, not just the absence of sickness or disability[4].
- **Practices:** described as the repetition of an activity to improve a skill.

- **Medical Laboratory Practitioners:** A variety of professions who provide health care services collaborate to identify the presence, severity, or absence of disease and to provide the information required to assess the efficacy of therapy[15,16,17].

Endnotes

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Chapter Two

Literature Review

2.1 Conceptual Review

Healthcare safety is a changing objective, as standards are updated year, causing an increase in concern. We now view an increasing number of incidents as medical laboratory practitioners' safety hazards[1]. Safety is frequently disregarded in poor nations like Nigeria, and the consequences have been catastrophic and expensive.

At order to reduce workplace dangers, medical laboratory professionals in hospitals must follow safety procedures. The laboratory staff members must operate responsibly and be mindful that careless behavior may have long-term consequences. They must receive training in order to recognize when dangers and hazards are rising and when responsibilities must follow. Personal practices, such as refraining from mouth pipetting, eating, drinking, smoking, chewing gum, applying cosmetics, removing contact lenses, or storing food or beverages in the lab or chemical refrigerator, play a significant role in reducing occupational hazards. Other practices include using the appropriate personal protective equipment for the job and refraining from mouth pipetting. In order to prevent medical laboratory professionals from contracting infections, standard precautions are established. When delivering medical care, standard precautions are a set of steps designed to stop the spread of blood-borne pathogens. The Centers for Disease Control (CDC) has advised that normal precautions be taken on all patients, regardless of knowledge about their infection status, since identification of individuals infected with these viruses cannot be consistently made by medical history and physical examination[2]. Regardless of a patient's diagnosis or anticipated infection state, the standard precautions stress the key components of universal precautions (intended to lower the danger of infections via wet body substances)[3]. When caring for patients, health care workers (HCWs) run the danger of being exposed to blood-borne illnesses such HIV and Hepatitis B and C virus as a result of sharps injuries and contact with bodily fluids [2-4]. In addition to having the greatest rate of HIV-positive individuals worldwide, developing nations also have the highest rate of needle-stick injuries [5]. According to the World Health Organization, these exposures are thought to be the cause of roughly 2.5% of HIV cases and 40% of HBV and HCV cases among health care workers globally [6]. There is a 1.2% to 10% risk of seroconversion after a patient with HCV antigen positivity sticks you with a needle [7]. Standard precautions are followed, which lowers the danger of exposure to blood and bodily fluids [7]. Gershon and his colleagues [8] noted that one of the correlates of excellent compliance was HCWs having a better understanding of universal precautions. Michalsen alongside his fellow colleagues [11] noted the same among medical professionals. The sort of training HCWs get may have an impact on their understanding of conventional precautions [11–13]. Standard precautions compliance on the part of healthcare personnel has been acknowledged as an effective strategy to prevent and control healthcare-associated infections in patients and healthcare personnel. [15, 16]. Hand washing, the use of barriers (gloves, gowns, caps, and masks), care with the tools, clothing, and clothing worn during care, environmental control (surface processing protocols and handling of health service waste), adequate disposal of sharp objects, and patient accommodations in accordance with requirement levels as an infection transmission source are all examples of standard precautions [15]. Among the recommended basic measures, hand hygiene is the most crucial [17, 18]. Another preventive action worth highlighting is the adoption of appropriate methods for handling needle sticks and other sharp objects in light of the potential for outbreaks, particularly of Hepatitis B and C [15]. Standard precautions (SP) should be carefully followed to prevent infections in patients and healthcare staff. Health worker questionnaires and observations in Nigeria and Africa show that recommended precautions are frequently not consistently followed by health workers[19,20]. When performing their routine clinical activities, laboratory scientists are among the healthcare professionals who face a substantial danger of coming into contact with blood and other bodily fluids directly [21]. Blood-borne infections contracted while receiving clinical and laboratory services continue to be a major global health concern, especially in low-income nations where such infections are associated with high morbidity and mortality [22]. There is selective adherence to universal precautions in daily medical practice, according to some research, and this variation in knowledge and adherence by healthcare professionals may be influenced by their various types of training [23]. Standard precautions (SPs) are guidelines or actions that are outlined to reduce the risk of occupational health hazards like exposure to blood borne pathogens (BBPs), blood and body fluids (BBFs), and viral infections (like HIV, HBV, and HCV, among others) from both known and unanticipated sources in the healthcare system [24,25].

Health Institutions

Laboratories, for example, which handle clinical materials, are particularly vulnerable to contamination and infection risk. A variety of activities are carried out in laboratories, including the handling of infectious patient samples with a visible microbial hazard to the professional and to the patient [18,26]. Other non-infectious hazards include exposure to cut, skin injuries, electric shock, fire, explosion, burns with corrosive chemicals, and poisoning with toxic substances. Other risks or issues with safety can develop in the lab itself due to physical agents such various instruments, electrical systems, and potentially harmful substances that are regularly employed in laboratory procedures [27].

The Medical Laboratory

Medical laboratories are designed to measure and examine samples from body fluids and tissues in order to provide information on disease diagnosis, prognosis, treatment, prevention, and therapy response. Medical laboratories are the major workplace for medical laboratory practitioners. It is impossible to overstate the importance of the role that the medical diagnostic laboratory performs. The medical laboratory is where human blood, tissues, urine, and other body fluids—often containing hazardous microorganisms—are transported for analysis, according to the International Organization for Standardization. Frequently, the instruments and chemicals needed to carry out the necessary testing have inherent risks of their own. The labor is often demanding, which causes stress, mishaps, and injuries. All people entering the laboratory must be trained, aware of the potential risks and hazards, and competent to carry out their duty effectively in order to deliver the crucial information that only a medical laboratory can provide [16]. To make them accessible to both doctors and their patients, the majority of medical laboratories are located inside or close to hospital buildings. Medical laboratories can deliver high-quality laboratory tests that are important for addressing medical and public health concerns, according to the classifications of these facilities that are shown below [28]. According to ownership, a facility may be privately owned as a component of a privately owned medical or healthcare institution, or it may be owned by the government and fall under the department of pathology or laboratory medicine in hospitals and medical centers [28]. Depending on its purpose, clinical laboratories can either be general clinical laboratories that offer routine diagnostic laboratory tests or they can be specialized laboratories that offer diagnostic and confirmatory tests for certain diseases [28]. Clinical Chemistry, Clinical Microbiology, Hematology, Blood banking and Serology (Immunohematology, Transfusion Medicine), Clinical Microscopy, Histopathology and Cytopathology, Molecular Biology, and Public Health (providing tests such as water analysis, testing for environmental substances, among other tests concerning public and environmental health) are the tests that facilities can offer in accordance with test specialization. These facilities function in a coordinated manner as a component of the laboratory network, which is typically governed and regulated by authorities at various levels of the network [28]. Regular patient screening, diagnostic (such as traditional and quick diagnostic tests), and follow-up testing are provided by peripheral laboratories, which are typically located in neighborhoods where residents may access their services. Intermediate-level laboratories can be found in district, provincial, and regional-level facilities; they can perform more tests than those offered by peripheral labs and can act as referral labs for unique cases (at the district level); in addition to conducting tests, they can also manage and supervise operations within their respective spheres of authority (especially for provincial and regional laboratories) [28]. National reference laboratories, also referred to as the central level, are responsible for overseeing and managing the laboratory network in terms of the implementation of policies and programs, training and development, monitoring and evaluation, and research. These facilities also offer a variety of routine and highly-specialized laboratory testing, including the introduction and gradual rollout of new diagnostic tests [28]. The importance of medical laboratories as a crucial component of the healthcare system was previously underappreciated [29]. But as time has gone on, more doctors have come to understand the value of laboratory tests in supporting their diagnoses and patient monitoring for treatment response. The role of clinical laboratories was employed for illness screening and surveillance, in addition to its proven value for specific patients, which was important for maintaining public health. Program managers evaluated the development of public, global, and international health programs on a broader scale by using various pertinent tests as surrogate indicators. To promote proper coordination and collaboration among clinical laboratories within the designated geographic areas, laboratory networks were built across nations and states [31]. Recent developments have seen a rise in the importance of quality management systems inside these laboratories, including the standardization of laboratory services, the strengthening of laboratory systems, and the creation of new, quick diagnostic tools. [32]. Testing is done in medical laboratories in a methodical and exact way. Each facility should adhere to the three phases of the laboratory testing process in general. To provide instructions for carrying out each step of the phase—pre-analytical, analytical, and post-analytical—standard operating procedure manuals and job aids are developed. [33, 34]. Medical laboratories, particularly in the present era, are frequently renowned for their cutting-edge equipment that does the majority of sample testing; yet, these facilities still primarily rely on the laboratory personnel to ensure that results are correct and trustworthy [35]. Diagnostic testing of the highest caliber is what all medical laboratories strive to provide. Numerous problems and issues must be resolved in order to achieve this aim, which emphasizes the importance of increasing laboratory capacity. Optimizing laboratory services offered to patients was found to require taking into account personnel and financial resources, planning and budgeting, quality assurance, logistics and supply, biosafety and equipment management, and other pertinent laboratory issues [35]. The acknowledgement of a medical laboratory's importance for the welfare of patients without sacrificing the health and safety of medical laboratory practitioners is the most crucial value for every healthcare professional as difficulties facing medical laboratories continue to emerge.

Sections In the Medical Laboratory

Chemical Pathology Laboratory

Chemical Pathology, also referred to as Clinical Chemistry, is a multidisciplinary field that combines chemistry, biochemistry, immunochemistry, endocrinology, toxicology (abuse and therapeutic drug testing), analytical chemistry, engineering, informatics, and probably other specialties to give doctors and other healthcare professionals the support they need to better diagnose and treat patients [36].

Hematology Laboratory

Hematology examines blood films in addition to analyzing whole blood specimens to perform full blood counts. Counting the number of cells in various physiological fluids is another specialty test [36].

Histopathology Laboratory

Histopathology examines microscopic samples of solid tissue taken from the body (biopsies) [36].

Medical Microbiology and Parasitology Laboratory

In microbiology, clinical materials such feces, urine, blood, sputum, cerebrospinal fluid, synovial fluid, and potentially contaminated tissue are cultured. The process at hand mostly entails examining cultures for potential infections, which, if discovered, are then further identified using biochemical testing. Additionally, sensitivity testing is done to see if the pathogen is susceptible to the drug or not. The type and dosage of the drug(s) that should be given for the patient are included in the results report together with the discovered organism(s) [36]. The study of parasites on specimens is known as parasitology. Fecal samples, for instance, can be checked for signs of intestinal parasites like hookworms or tapeworms [36].

Virology Laboratory

Identification of viruses in samples such blood, urine, and cerebrospinal fluid is the focus of virology [36].

Health Care Workers

Healthcare workers include anyone who works in a medical setting and may come into contact with bodily fluids, contaminated medical supplies and equipment, polluted ambient surfaces, or even contaminated air [5]. They include, but are not limited to, medical professionals, nurses, technicians, therapists, pharmacists, nursing assistants, laboratory staff, autopsy staff, emergency medical service staff, dental staff, students and trainees, contract staff not employed by the healthcare facility, and people who are not directly involved in patient care but who could be exposed to infectious agents, such as volunteers, dietary staff, housekeeping staff, maintenance staff, and clerical staff. [37]. It is important to protect healthcare professionals since they are more likely to contract viral illnesses like hepatitis B, hepatitis C, and the human immunodeficiency virus (HIV). In addition, the security of healthcare professionals is crucial in light of epidemic outbreaks of diseases like Ebola and Lassa fever, both of which frequently result in fatalities [5,38,39,40]. According to the World Health Organization (WHO), 3 million HCWs are exposed to blood-borne viruses during work each year. Nearly 90% of the illnesses brought on by these exposures occur in low-income nations [41]. Developing nations, particularly those in sub-Saharan Africa, have the greatest rates of workplace exposures and the highest frequency of Human Immuno Deficiency Virus (HIV)-positive people worldwide [42].

Medical Laboratory Practitioners

A variety of professions who provide health care services collaborate to identify the presence, severity, or absence of disease and to provide the information required to assess the efficacy of therapy [43, 44, 45]. The art of medicine includes making a clinical diagnosis with following test confirmation. Medical laboratory science is one of the most significant fields among allied health care providers because it provides accurate information to those in charge of patient treatment, setting health priorities and resource allocation, observing the emergence and spread of infectious pathogens, and formulating effective control strategies against major prevalent diseases [18,46]. Without dependable medical laboratory support, patients are less likely to receive the best care available, the cause of illness might not be correctly identified, and epidemics and the spread of serious infectious diseases won't be reliably stopped [18,47]. Health workers who undertake laboratory analysis and, in some countries, phlebotomy to gather samples are known as medical laboratory professionals. Physicians receive the findings of laboratory analyses from them, and these results are then used to monitor and prevent disease as well as diagnose and treat patients. They are one of the biggest categories of licensed healthcare workers in Nigeria. They work in medical facilities like hospitals, as well as in educational and research facilities. Within a clinical laboratory, there are many different positions available. Roles are based on a career ladder of technical and academic milestones. The laboratory director, technical and general supervisors, scientists/technologists, technicians, and attendants are the primary members of a clinical laboratory team; however, terminology has changed slightly over time and may vary from place to location. Additionally, managers are present in laboratories to oversee daily activities. Even though they might not be testing your samples, these experts are crucial to the smooth operation of the laboratory because the majority of them have training and expertise in the technical parts of the lab.

Which are;

Laboratory Director

A PhD scientist or, occasionally, a medical laboratory scientist serves as the laboratory's director. He or she must adhere to the rules set forth by the federal law that his country's public or private laboratories must follow. Regardless of the director's credentials, the director is in charge of overseeing all aspects of the laboratory's operations, including upholding the standards of the organizations that inspect and accredit the facility and making sure that all technical, clinical, and administrative tasks are carried out.

Technical and General Supervisors

Technical or general supervisors may also work in medical laboratories, albeit certain organizational structures may use a different title for the position. The technical supervisor may also be the lab director. is in charge of managing the lab's technical and scientific aspects. The technical supervisor's credentials may also apply to a general supervisor, sometimes known as the laboratory manager. A general supervisor is in charge of keeping an eye on both the employees doing the tests and reporting the results in the laboratory on a daily basis 48.

Medical Laboratory Scientist (MLS)

In order to diagnose and/or assist in the treatment of disease, these laboratory professionals are responsible for carrying out routine as well as highly specialized tests, troubleshooting (preventing and solving problems with results, specimens, or instruments), and communicating test results to the pathologist or treating healthcare professional. Under a microscope, they may look for bacteria, parasites, fungi, or cells that could be signs of cancer or other disorders in samples of blood or bodily fluid. They carry out quality assurance inspections, assess new tools, and put new test methods into practice. Additionally, scientists may take on managerial responsibilities, such as managing laboratory staff as the general and/or technical supervisor [48]. Numerous scientists focus on a single discipline, such as hematology, clinical chemistry, immunology, molecular pathology, cytogenetics, microbiology, or transfusion medicine. The majority of labs want certification as proof of their capability to carry out their duties 48.

Medical Laboratory Technician (MLT)

In all areas of the clinical laboratory, routine tests are carried out by a medical laboratory technician (MLT). MLTs will conduct tests using microscopes in addition to other laboratory equipment and procedures. They might have specific lab specialties, such like medical/clinical laboratory scientists [48].

Medical Laboratory Assistants

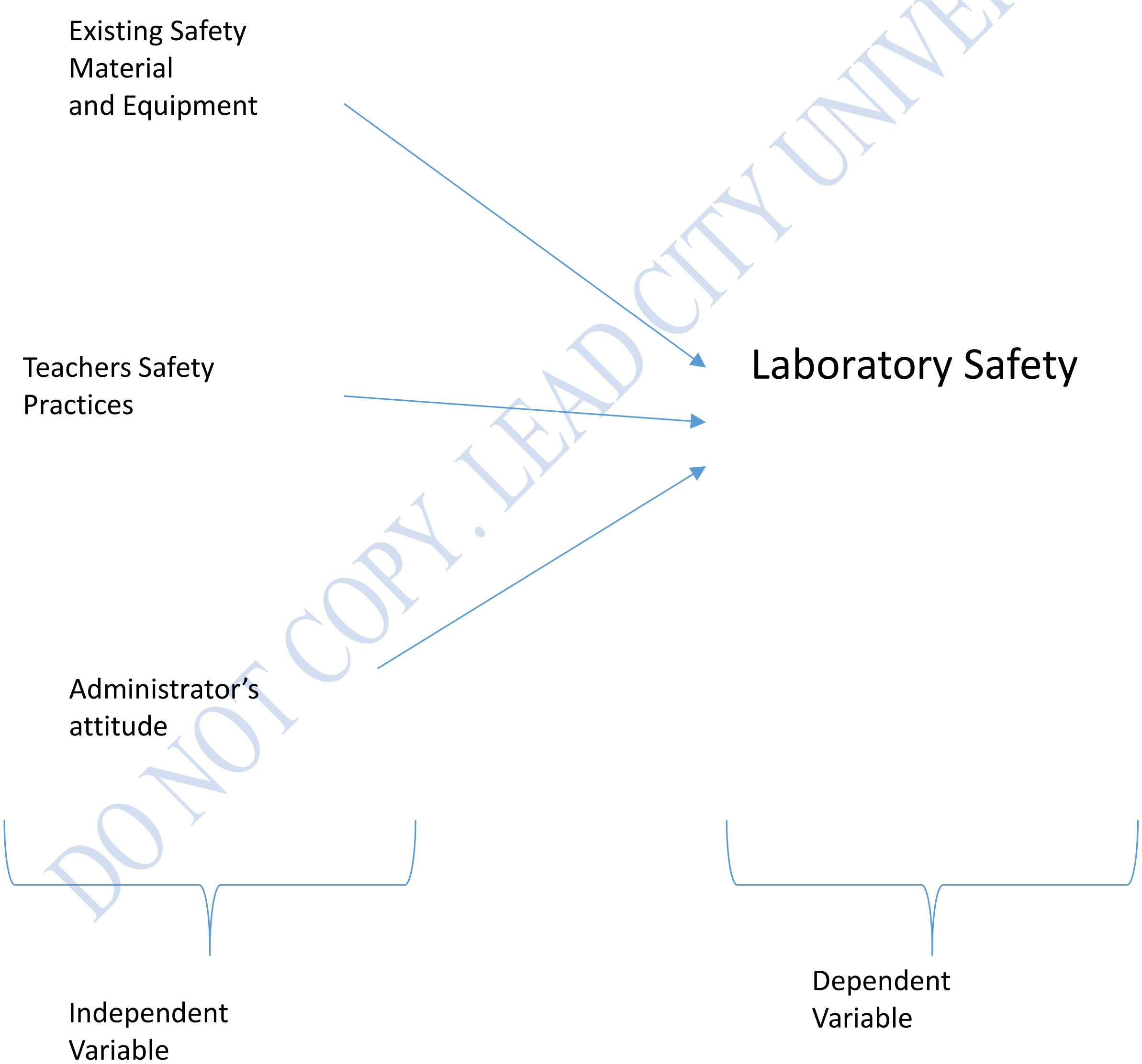
Working directly with patients, medical lab assistants receive, collect, and sort samples. They classify, prepare, and handle samples that will be examined and evaluated by a medical laboratory technician or other medical expert. Pre-analytical procedures are performed on specimens from a variety of sources, such as preparing slides of blood and other fluids for examination under a microscope. They also check information on documents that accompany specimens, enter data into computers, collect, label, and deliver specimens, such as blood samples, set up, operate, and maintain laboratory equipment, adhere to safety protocols and procedures in the lab, handle hazardous materials, make chemical solutions, and prepare stocks of chemicals.

Medical Laboratory Attendants

The preparation and processing work for laboratory tests and experiments is supported by the laboratory attendant. He or she is in charge of keeping the laboratory clean and maintaining the inventory. He or she works under direct supervision to complete regular and semi-skilled tasks related to the gathering, processing, and distribution of field samples as well as the upkeep of laboratory tools and glassware [48].

2.2 Theoretical Review

According to research by Salleh along with fellow researchers, the theoretical framework shown below describes how current safety tools and supplies, instructors' safety practices, and administrators' attitudes toward laboratory safety interact to determine laboratory safety. The primary variable of interest in the study was the dependent variables, such as laboratory safety. The model further suggested that current safety equipment and supplies, instructor safety practices, and administrator attitude are independent variables or traits that have been associated to laboratory safety [49].



Similarly, in investigation the occupational safety management framework for healthcare and social assistance service providers, the methodology proposed in the study was predicted on the idea that a number of variables affect and have an influence on safety management in healthcare and social support organizations. It looked at the occupational safety management framework for service providers in these fields. The researcher created a conceptual framework based on the findings of the current state study and the best practices of healthcare safety management found in the relevant literature. This conceptual framework uses eight components to create an organizational safety management that is based on HCSAW safety management and perceptions. This framework also takes into account the demographics and professional characteristics that are thought to influence how safety is viewed and managed. The researcher also added a few other variables since he reasoned that they would have an impact on the workplace safety culture in the hospital and living units at Invalidiliitto Järvenpää [49].

These factors were divided into three groups.

Healthcare And Social Assistance Worker

The dependent variables in this study measure how employees feel about their workplace safety and the company's safety culture. Patients are questioned about their feelings and responses to situations that can be harmful to their health in order to care for them. The acquired data was then used to determine the positive and negative replies, which were then measured using a five-point scale using the safety attitude questionnaires (SAQ), a well-known survey that had been designed for service providers. General assessment of safety in the manner in which HCSAW approaches patients and clients while providing care for the business is examined in this examination of their attitudes, beliefs, values, and safety perceptions. Patient safety impressions were created for each responder by estimating the mean proportion of positive replies from data gathered from survey questionnaires and evaluating on a modified 5-point Likert scale (yes, no, sometimes, once and neither). Ergonomics' safety implications: This has to do with how workers view using ergonomic tools and equipment in the course of their regular interactions with clients, as well as if receiving sufficient training on how to use these tools and equipment would improve their performance and whether it will have an influence on their health. Additionally, a modified 5-likert scale was used to evaluate this. The phrase "biological safety factors" describes how workers view biological elements, such as illness and other blood-borne infections, and whether they pose a threat to their safety. The identical Likert 5 scales were employed to evaluate it. Elemental physical security Violence, assault, and other job dangers are among the physical risks that HCSA personnel face on a regular basis. The physical risk portion of the SAQ question aims to identify any safety issues in this sector. In addition, it was evaluated using a modified 45-likert scale (never, rarely, often maybe and always). Psychosocial safety issues can refer to worries about stress, weariness, burnout, and other psychological dangers and threats that HCSA personnel experience at work. It was evaluated using the identical modified 5-Likert scale. (Yes, no, occasionally, once, neither, nor neither). Cleaning agents and other chemicals that HCSA staff use while working are mentioned, along with the risks and safety issues associated with handling them. It received a 5-point rating. (Never, seldom, often, possibly, and always). In this industry, it is used to describe how frequently personnel report incidents and mistakes, risks seen, safety blunders recorded, latent errors, and near misses. On a 5-point scale, it was rated. (Yes, No, Occasionally, On Occasion, And Neither). The ability of a worker to raise a potential safety concern or scenario without it having a negative influence on their employment as well as the sense that employees have that their mistake is being used against them are referred to as communication and punitive responses to errors. (Never, infrequently, frequently, possibly, and always)

Gender: This only applies to the genders of the study's participants.

Age: Indicates the age of the individual 18 to 62.

Education level: This is in reference to the participant's educational background, which was grouped as follows: 1 year of elementary school (social or personal assistants). Schools for practical nursing last three years (ammattikoulu), there are 3.5-year polytechnic (AMK) degrees available for occupational and physical therapists.

Experience and number of years employed: The range is 0–1 year, 1–5 years, 5–10 years, and 10 years or more, and it describes the amount of experience and years each participant has worked.

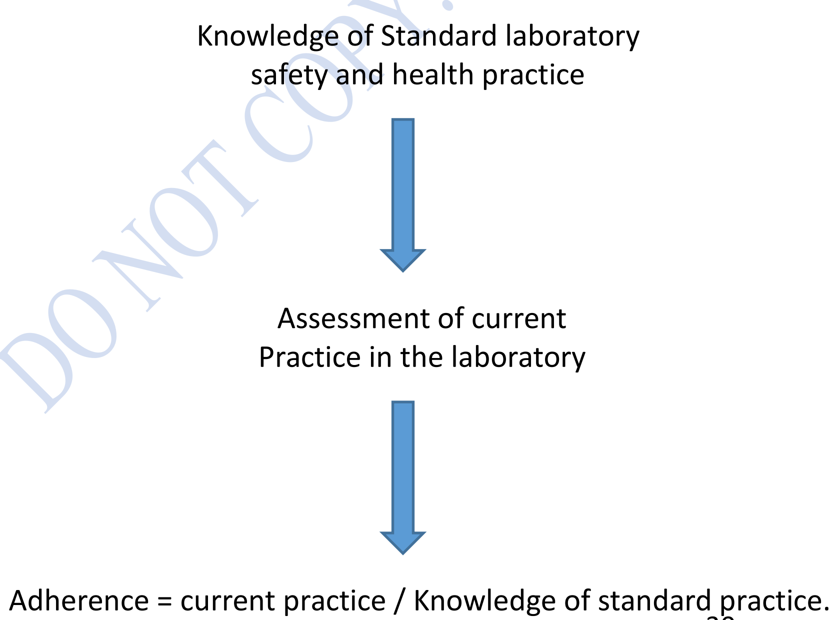
Participant's occupations: The healthcare support staff includes two physiotherapists, two occupational therapists, practical nurses, and personal assistants.

2.3 Review of Empirical Study

Standard precautions (SP) should be carefully followed to keep both patients and healthcare personnel safe from various infections. Health workers frequently fail to follow recommended precautions consistently and accurately, according to surveys and observations in Nigeria and Africa [19, 22]. Laboratory scientists are healthcare professionals that face a high danger of coming into contact with blood and other bodily fluids while doing their regular clinical duties [23]. Blood-borne infections contracted while receiving clinical and laboratory services continue to be a major global health concern, especially in low-income nations where such infections are associated with high morbidity and mortality [24]. There is selective adherence to universal precautions in daily medical practice, according to some research, and this variation in knowledge and adherence by healthcare professionals may be influenced by their various types of training [24]. There are numerous reasons why healthcare professionals don't follow the fundamental guidelines of universal precautions [26,27]. (Marcus *et al.,* 1988) observed that 37% of exposures to blood borne infection hazards might have been avoided if infection control precautions were followed and came to the conclusion that doing so considerably reduced exposure [60]. In Nigeria, there have been a number of studies on knowledge and compliance with SP, but no clear evidence of professional disparities has been found [24, 61]. As an illustration, a cross-sectional study by Abdulraheem and his colleagues (2017) reveals that around one third (33.3%) of the survey's respondents were aware that the goal of conventional precautions was to shield patients and healthcare professionals from the spread of infection. However, it was proposed that health workers' ability be built in order to improve their knowledge of adhering to safety and healthy practices because they had a limited understanding of and awareness of basic measures. The first handling of biohazards, safety rules, safety procedures, handling safe of goods and equipment, monitoring of possible exposure, and hazard [24] should all be included in regular training. Additionally, their investigation found no consequences for not employing protective equipment. Supply availability and awareness campaigns boost adherence to recommended safeguards. Following an educational symposium [62] and a 30-minute teaching session, studies have shown a considerable increase in adherence to the recommended safeguards from 48% to 74%. In their study, among health professionals with the knowledge, hand hygiene compliance was 38.7%. Their results support those from earlier investigations [64, 65]. predictor of disregard for all precautions against bloodborne viruses, demonstrating that education and awareness, while essential, are insufficient to promote a change in behavior with regard to hand cleanliness. Although the amount of use increases with age, the use of gloves was 18% (with 5 years of experience). This result is almost identical to one from Pakistan, where 20.9% of healthcare professionals used gloves "most of the time" to "always," according to [66]. In their investigation, Zaveri & Karia (2017) came to the conclusion that these highly exposed laboratory personnel have inadequate knowledge of and compliance with general work precautions. Extensive training on universal precaution commitment to safety and safer work practices by hospital administration are suggestions for improving inadequacies that have been discovered. While instructions for post prophylaxis should be extensively communicated, it is also recommended that staff members have hepatitis B vaccinations [55]. This is consistent with 2009 research to assess the biosafety measures used by diagnostic facilities in Khartoum state. The study came to the conclusion that the diagnostic laboratories in Khartoum state had very lax requirements for biosafety procedures. The laboratory staff's awareness of the use of biosafety concepts was also relatively low. In summary, the study discovered that a relatively small fraction of laboratory staff members actually wore lab coats and gloves during all laboratory activities. Additionally, none of the staff members in these diagnostics laboratories had the necessary biosafety training, per [67]. Finally, a cross-sectional observational study conducted in Dhaka City found that laboratory workers' biosafety awareness and training was deficient. The Guideline must include biosafety as a course topic, provide biosafety training both in-class and on-the-job, implement a motivational program, provide regular supplies, and provide adequate physical, financial, and prophylactic support as well as regular supervision and system upgrades for waste disposal. In contrast to the conclusions drawn from the studies mentioned above, a cross-sectional KAP study about OHS awareness among MLPs working in the pathology, microbiology, and biochemistry departments was carried out from January to February 2011 at India Krishna Institute of Medical Science, Karad. From these 19 study participants, laboratory technicians working in pathology had a knowledge level of 50% moderate and 50% high, while laboratory technicians working in biochemistry had a knowledge level of 25% moderate and 75% high, and laboratory technicians working in microbiology had a knowledge level of 100% high. 16.7% of MLPs who work in pathology reported having a positive attitude. Unlike biochemistry, where 12.5% of people had a negative attitude, 100% of people in microbiology had a positive attitude. Regarding the problem of practice, 16.7% of MLPs working in pathology had poor, 66.7% had fair, and 16.7% had good practice. Additionally, 12.5% of biochemistry students had good practice 69, while 81.5% had fair practice. This demonstrated that medical laboratory professionals have a positive attitude toward adhering to workplace safety and health standards. Various studies on personal protective equipment have been conducted in numerous laboratories across the world. In order to ascertain compliance rates with advised safety measures against exposure to blood borne pathogens and the justification for current behaviors, a study was carried out in laboratories across Canada. Laboratory employees reported high rates of bodily fluid exposure and low rates of personal protective behavior adherence. This nationwide investigation has discovered various flaws and suggested several solutions [70]. The main conclusions of Kahhaleh and his colleagues in 2005 study on laboratory staff in Lebanon's adherence to universal precautions offer some intriguing new information about the issue of preventing the spread of pathogens (such as HIV, hepatitis virus, etc.) through preventive measures employed by laboratory technicians in Lebanon [71]. The study found significant gaps across technicians in terms of knowledge, attitudes, and practices, despite their relatively high levels of education and extensive knowledge of the infections' transmission mechanisms. [72]. On the one hand, there were accessible and employed to varying degrees protection mechanisms to prevent skin and mucous membrane contamination with blood or bodily fluids, such as routine hand washing or the use of barrier protection, including gloves of the correct quality and protective body apparel. This is a very effective laboratory technique for lowering exposure from prolonged or significant skin contamination with infectious fluids[73]. However, it was found that only 37% of laboratories have technicians who strictly adhere to this precaution, despite the wide availability of gloves reported by both laboratory directors and technicians, excellent knowledge of the protective effectiveness of wearing gloves, the high rate of belief in this practice, and reports from 92.8% of technicians. They observed a little rise (7.3%) in this practice from the prior survey, which is insufficient. In a laboratory, it was discovered that either all of the technicians wore gloves or none of them did. When performing laboratory tasks that frequently lead to contaminated hands, gloves don't need to be changed. “Blood and body-fluid precautions," which should be applied consistently for all patients, were among the recommendations made by the Centers for Disease Control in 1987, modified in 1988, and revisited in 1991. Instead, gloves should be changed when these duties are finished [75]. Finally, it became clear from their investigation that most laboratory employees did not understand such a complete strategy. Therefore, all technicians and laboratory directors need to receive a thorough explanation of the idea, application, and efficacy of universal precautions [72]. Workers of the Pathology Laboratory at King Abdulaziz Medical City in Riyadh, Saudi Arabia, participated in a survey about health and safety. According to an analysis of 154 completed questionnaires, 61% of respondents were female, and 49% of respondents were under the age of 30. 88% of those polled reported regularly handling blood and blood-derived products. It was discovered that 14% of participants had experienced a needle stick injury and 8% had splashes in their mouths or eyes; 2% had not reported these exposures. 92% of workers used gloves completely when handling blood or blood-related goods. After taking off their gloves, just 61% of respondents cleansed their hands. Additionally, just 17% of people reported utilizing face shields or goggles when handling bodily fluids outside of a biological safety cabinet. Lack of availability (30%), not deemed required (18%), and interference with job (8%) were stated as justifications. 92% of people followed the safe disposal of sharps in a sharps container. This country's initial report outlined various shortcomings and suggested ways to fix them. These findings are crucial for developing efficient health and safety measures and for providing pertinent and targeted education to lower workplace dangers and injuries. In their respective labs in Al-Madinah city, Khabour and his coworkers also evaluate the skills and attitudes of laboratory staff toward biosafety procedures. Additionally, the examinations of medical laboratories' adherence to safety requirements.Studies revealed that the majority of laboratories in the city of Al-Madinah adhered to safety standards for their facilities and equipment. The majority of the staff complied with safety rules on the disposal of medical waste, the use of sharp objects, handling sample spills, donning a lab coat, etc.[77]. Some habits, including as drinking and eating in the laboratory, using cell phones, working with finger wounds and torn gloves, and failing to use eye protection and masks are not acceptable, and treatments have been recommended [77]. Another study by Karim and Choe (2017) indicated that accidents occurred in the pathology laboratories of Hospital Ipoh. These incidents occurred in the Histology (40%), Microbiology (33%), Haematology (20%), and Cytology (7%) laboratories. Sharp object cuts accounted for 47 percent of the cases. Blood or chemical squirts and splashes account for about 27% of injuries. There was one instance of each of the following: unintentional ingestion of disinfectant [78], burn, contact with biohazardous fluid, and hypersensitivity reactions. Additionally, it is crucial to be aware of the dangers posed by chemicals, radiation, fire, and waste disposal. According to statistics, there are more than 5000 burn injuries caused by explosions and fires related to construction projects each year in the UK (Mian, 2011). However, studies highlight how crucial attitudes, perceptions, and behaviors of laboratory employees towards safety procedures are. The prevention of hazards in laboratories necessitates a thorough comprehension of the dangers, and the laboratory staff should become familiar with "universal precautions" [55]. A study by (Adel and his colleagues 2017) [79] indicated that the reporting system for laboratory accidents and spill clean-up was not fully implemented and that the percentage of the parameters used was low compared to a study of a similar nature. In 2017, Ndu and Sussan came to the conclusion that Standard Precautions understanding and practice are still lacking, and as a result, MLS needs to be trained on the SP's components. SP regulations must be upheld, and practice areas must be constantly supplied. Their research showed that while MLSs have a positive attitude toward common precautions, their level of understanding and compliance is quite low. Reiterating the need of hand cleanliness, wearing personal protection equipment, and needle safety is necessary. There should be more frequent and regular training on using personal protective equipment and common safety precautions [81]. They recommended that all health professionals should learn about standard precautions in their training. The management of the hospital should enforce its policies and supply the tools necessary for the conduct of infection control. A study of the occupational safety and health status of medical laboratories in Kenya's Kajiado County was also conducted in 2018 by Fridah and colleagues. In Kenya's Kajiado County, their study assessed the state of OSH in medical laboratories. The goals included identifying biological, chemical, and physical dangers; examining medical laboratories' control methods; and listing obstacles to the application of OSH best practices [82]. The most frequent types of risks found in medical laboratories were found to be microorganisms (80% for biological risks), handling unlabeled and unmarked chemicals (38.2% for chemical risks), and improperly positioned laboratory equipment (49.5% for physical risks). Their research indicates that failure to use personal protective equipment was statistically linked to risk exposure, as shown by Pearson's Product Moment Correlation study. At the 0.01 significance level, individual control measures were statistically significant. Only 65.1% of the elements influencing OSH adoption in medical laboratories were found, and their findings showed that training had the greatest impact on effective OSH procedures. Their findings appeared to be supported by earlier empirical research [83, 84, 85]. Insufficient safety training was the main contributing factor to major workplace accidents because employees lacked the knowledge and abilities to recognize potential hazards, according to a study on the relationship between employees' perceptions of safety and organizational culture [86, 87]. Their findings on staff OSH training are also comparable to that study's findings. In a related study, businesses that placed a strong emphasis on safety through management practices and training saw a rise in employee adherence to safety regulations [88]. According to a separate study, [85] employees who have undergone safety training are likely to report fewer workplace accidents than their untrained peers. The benefits of training for workers in managing their work and improving occupational safety have been further demonstrated by additional studies [89]. According to the study done by Tooba and others, in their study on the Knowledge, Attitude and practice of Laboratory Safety Measures among Allied Health Staff of pathology revealed 171 (68.4%) of the staff had knowledge about laboratory safety while 43 (17.2%) did not give correct answers and 36 (14.4%) were unclear in knowledge. Regarding the attitude and beliefs of the Laboratory workers, the correct response rate was 208 (83.2%) while 42 (16.8%) did not answer correctly. In practice of Laboratory safety procedures 193 (77.2%) answered correctly and 57 (22.8%) were not practicing. 144 (57.6%) were female participants and 106 (42.4%) were male. A study showing the level of compliance to infections control practice among the private medical laboratory workers in Lagos state, Nigeria includes a total number of 164 participants, comprising of sixty-five seven males and ninety-seven females. The level of compliance to infections control practice was investigated using questionnaires and other statistical instruments. The study reveals that majority of the respondents complied with the use of hand gloves (86%), laboratory coat (70.1%) and safety boots (51.2%). 86% of the respondents wash hands after attending to patients 'samples, 62.2% recap needles [9] to prevents needle prick. However, (36.6%) of the staff do not eat, drink, chew in the laboratories. A greater percentage of the workers stated that the use of puncture proof waste bins (79.3%), coded biohazard bags for sorting of wastes, (69.5%) and government approved waste disposal agents (78.1%), were acceptable methods of waste management and disposal. 67.7% of the respondents agreed that their laboratories have safety officer as part of their safety measures. Low percentages however, were recorded in terms of regular visitation of the regulating agencies to the laboratories. This study indicated moderate to high self-reported compliance with some of the components of standard infection control practices among private medical laboratories in Lagos state. However, there is a need for training and retraining among the workers and improved monitoring by the responsible agencies for greater output [107]. The adherence of medical laboratory technicians (MLT) to infection control guidelines is essential for reducing the risk of exposure to infectious agents. A study explored the adherence of MLT towards infection control practices during the COVID-19 pandemic. The study population involves 444 participants who worked in private and government health sectors in Jordan. The findings shows that more than 87% of the participants reported adherence to hand-washing guidelines and using personal protective equipment (PPE) when they interacted with patients (74.5%), and handling clinical samples (70.0%). Also, 88.1%, 48.2%, and 7.7% reported wearing of lab coats, face masks, and goggles, at all times, respectively. MLT reported very good adherence with most assessed infection control practices. This may be due to the COVID-19 pandemic era [108]. Another study evaluated the effect of safety training program for laboratory workers' regarding prevention of occupational hazards. The study was conducted at four governmental hospitals in Benha City, 100 laboratory workers (100) whom are working at the four hospitals were participated in this study. The result of the study showed a significant positive effect of the program on knowledge and practices of the laboratory workers ($P < 0.001$). The study also concluded that the program has positive effect to upgrade the laboratory workers' knowledge and improving their practices regarding prevention of occupational hazards ($P < 0.001$). It was recommended that regulatory training program should be strengthened to ensure basic lab safety practices in hospitals, and providing training courses for large number of hospitals laboratory workers about prevention of occupational hazards and safety environmental condition[109] .A study assess healthcare workers' needle-stick injury (NSI) knowledge, attitudes and practices (KAP) conducted in a 600-bedded hospital throughout six months. The knowledge, attitude and practice of the participants regarding NSI were assessed. The results shows that the study emphasizes that applying knowledge to practice is required to prevent NSIs. Various recommendations to help prevent and deal with NSIs were made[110]. Also, a study also assesses the occupational health hazards faced by healthcare workers and the mitigation measures. Method among 200 respondents who worked in 8 major health facilities in Kampala. The results show that, 50.0% of respondents reported experiencing an occupational health hazard. Among these, 39.5% experienced biological hazards while 31.5% experienced non biological hazards. Predictors for experiencing hazards included not wearing the necessary personal protective equipment (PPE), working overtime, job related pressures, and working in multiple health facilities. It was concluded that Healthcare workers in this setting experience several hazards in their workplaces. Associated factors include not wearing all necessary protective equipment, working overtime, experiencing work related pressures, and working in multiple facilities. Interventions were advised to be instituted to mitigate the hazards. [111]

2.4 Conceptual Framework

Below is a conceptual framework for this study that will be used to accomplish the study's goals.



When determining the level of compliance, a comparison is performed between the knowledge of the recommended health and safety procedures that should be acquired in a laboratory and the evaluation of the existing procedure to see if it adheres to the recommended procedure. The respondent would be judged as conforming to the standard practice if the respondents can demonstrate that the practice is in line with the standard practice and the resources that should be in the laboratory are present.

Knowledge Of Standard Practice

Standard Precautions

A group of infection control procedures known as "standard precautions" are used to stop the spread of diseases that can be contracted by contact with blood, bodily fluids, and non-intact skin, including rashes and mucous membranes. They are the fundamental infection control safeguards that must be utilized at a bare minimum in the treatment of all patients. The universal precautions (created to lower the risk of infections from wet bodily substances) are emphasized in the standard precautions, which are applied to all patients receiving care in hospitals regardless of diagnosis or suspected infection status [51]. Health care workers can be shielded against a variety of illnesses, such as the human immunodeficiency virus, hepatitis B and hepatitis C from sharps injuries and contact with bodily fluids, by following conventional precautions, according to research [42]. According to WHO estimates, these exposures cause roughly 2.5% of HIV cases and 40% of Hepatitis B and C cases in healthcare workers 51. Hand washing before and after every instance of patient contact, the use of personal protective equipment, the safe handling and disposal of sharps, routine environmental cleaning, the processing of reusable medical equipment and instruments, respiratory hygiene and cough etiquette, aseptic non-touch technique, waste management, and proper handling of linen [51] are all examples of standard precautions. For all staff members caring for all patients, several hospitals have implemented standard precaution policies that cover all aspects of barrier use, including hand washing, the use of personal protective equipment (PPE), such as gloves, protective face and eye gear, gowns, and protective apparel, as well as patient placement and safeguards when handling laboratory specimens [51]. Standard precautions (SP) should be carefully followed to prevent infections in patients and healthcare staff. Health worker questionnaires and observations in Nigeria and Africa show that recommended precautions are frequently not consistently followed by health workers[19,20]. In the course of their routine clinical activities, medical practitioners and laboratory scientists are among the healthcare professionals who face a substantial risk of direct exposure to blood and other bodily fluids [21]. Blood-borne infections contracted while receiving clinical and laboratory services continue to be a major global health concern, especially in low-income nations where such infections are associated with high morbidity and mortality [22]. There is selective adherence to universal precautions in daily medical practice, according to some research, and this variation in knowledge and adherence by healthcare professionals may be influenced by their various types of training [23]. Standard precautions (SPs) are guidelines or actions that are outlined to reduce the risk of occupational health hazards like exposure to bloodborne pathogens (BBPs), blood and body fluids (BBFs), and viral infections (like HIV, HBV, and HCV, among others) from both known and unanticipated sources in the healthcare system [24,25].

2.4.1 Operational Definition of Conceptions/Terms/Variables

2.4.1.1 Safety

A means of preventing accidents or minimizing potential personal injury or property damage is known as safety [1]. Safety was also described by the International Organization for Standardization as a planned program procedure with a requirement for routine audit and review [16].

2.4.1.2 Health

WHO defines health as the fullest possible condition of physical, mental, and social well-being, not just the absence of sickness or disability. Since human survival depends on health, all efforts must be directed at utilizing this vital resource [4, 17].

2.4.1.3 Safety and Health in the Laboratory

All medical practitioners must adhere to safe and healthy practices, and medical laboratory professionals are especially crucial in this regard. Medical laboratory practitioners are frequently exposed to a variety of biological, chemical, and physical occupational hazards [52], which pose health risks to them. Basically, these occupational risk exposures result from the way laboratory personnel handle and consume substances during regular work hours [53]. Typically, the pathogenic agents to which lab personnel are frequently exposed include serum hepatitis virus [54], Brucella, and *Mycobacterium tuberculosis*. The laboratory employees are exposed to dangers from chemical toxicity, needlestick injuries, cuts from skin-related illnesses, and the chance of developing cancer from regular exposure to radiological waves in terms of physical and chemical hazards. Hazardous materials are present in the laboratory setting itself. Medical labs may be dangerous places. The medical laboratory setting can be a dangerous place to work since it primarily presents radiation, explosion, chemical, glassware, and microbiological risks. As a result, workplace dangers are frequently encountered by workers. As a result, unless adequate preventive defense measures are implemented, the person's health and safety may be seriously affected [55]. The medical laboratory is another place of employment where numerous occupational hazards, such as chemicals, sophisticated equipment, and possible diseases, are regularly encountered. However, if potential hazards are identified and safety and infection control procedures are followed, the laboratory can be a secure place to work and study. It is crucial that health care workers are informed about the overall prevalence, transmission risk, and accessibility of prophylactic and treatment [56]. The majority of the waste found in laboratories is pathological (including some anatomical), highly infectious (small pieces of tissue, microbiological cultures, stocks of infectious agents, infected animal carcasses, blood and other body fluids), sharps, radioactive in some cases, and chemical in others. To minimize the potential release of these chemicals, extra care must be exercised. Each lab that uses an infectious agent is required to complete additional lab-specific training. When handling hazardous compounds, laboratory staff must use acceptable procedures and methods. Thus, when we talk about major obstacles, we're talking about security measures like engineering controls. While secondary barriers are the facility design and structure, this includes not only personal protective equipment but also safety cabinets, fume hoods, vaccinations, and autoclaves. These barriers are there to safeguard those outside the lab, the surrounding area, and the environment. Despite the tight safety procedures [58, 59], a fire that broke out in the University of California, Los Angeles (UCLA) laboratory in 2008 caused one of the staff members to lose his life.

2.5 Summary of Reviewed Literature

Infectious and non-infectious dangers are exacerbated in clinical laboratories by unsafe working conditions, disposable waste products, and chemicals. Less safety exists for the community, staff, and patients. In medical laboratories, ensuring a secure workplace is not automatic. It is a proactive process of planning, carrying out, observing, and evaluating with the intention of improving. It is an active procedure to guarantee competence and expertise.

2.5.1 Recent Advances on Safety And Healthy Practices

Workers in laboratories must be informed about safety, under ISO 15190:2003. A safety document that is kept up to date and current must be provided by the laboratory [16]. The personnel is expected to read the manual, which must be easily accessible. Additionally, it is necessary to develop worker safety training programs for all new hires and to repeat them for seasoned personnel [16]. Individuals should receive training that is adapted to their needs. Each employee must show proof of understanding the topic, and their training experiences must be kept and recorded. The training program cannot be created just once. Regular evaluations of the training program are necessary, and ongoing adjustments must be made [16]. It was confirmed in a Pakistani study on the behaviors and biosafety awareness of laboratory employees that these employees lack knowledge of good laboratory practices and biosafety measures and do not strictly adhere to the recommendations for good laboratory practices [90]. The study emphasizes the necessity of educating and retraining laboratory staff in order to raise their awareness of proper laboratory practices and self-hygienic concepts. Additionally, to closely supervise each Medical Laboratory Practitioner regarding the requirement to correctly abide by safety and healthy practices done in different Medical Laboratories across Ibadan South West Local Government for both their safety and the safety of the patient.

2.5.2 Safe Practices Required by Medical Laboratory Practitioners

The danger of error, accident, and injury increases if the laboratory environment is not established and maintained as a safe workplace, according to the International Organization for Standardization's ISO 15190:2003. Making sure that safety equipment is available, is known to be functioning properly, and personnel is trained in its proper use is part of creating a safe atmosphere. While advanced laboratories will need specialist apparatus such as biological safety cabinets, chemical safety hoods (also known as fume hoods), and alarm systems, basic safe settings can be created with straightforward precautions and basic apparatus that is in good working order [16]. By making sure that workers are in non-glare lighting, giving them a comfortable workspace that lowers the risk of stress and strain, and providing adequate ventilation to regulate heat and humidity, safety is improved. Reducing distracting noise levels improves safety. Lockable doors and signs warning workers and others that laboratories may contain materials and products that could be hazardous if not handled appropriately help to ensure security and improve safety [16]. The provision of stations for efficient hand washing and the availability of suitable first aid supplies in the extremely unlikely event that unintentional exposures do occur are required by laboratories [16]. Safe laboratories are regularly kept tidy and clean. Workers must have access to personal protective equipment, such as goggles, respirator masks, protective gowns, and masks, and must be taught in using it in order to prevent accidents [16]. Every laboratory has the ability to provide a safe working environment by meeting these requirements. They are specifically listed in the standard as being necessary elements of a secure laboratory [16]. The environments in which healthcare personnel offer patient care are among the riskiest places to work. The lives, safety, and well-being of healthcare workers are threatened by occupational hazards such as biological, chemical, physical, ergonomic, psychosocial, fire and explosion, and electrical dangers. One in ten healthcare professionals worldwide are thought to sustain a sharp injury each year.

16,000 hepatitis C virus (HCV), 66,000 hepatitis B virus (HBV), and 1,000 human immunodeficiency virus (HIV) infections were brought on by sharps injuries to healthcare personnel in the year 2000. These infections have a substantial effect. According to estimates, between 2000 and 2030, these infections will likely result in 145 HCV-related premature deaths, 261 HBV-related premature deaths, and 736 HIV-related premature deaths. The few studies that have been done in sub-Saharan Africa have shown that healthcare workers there routinely encounter biological, chemical, and physical occupational dangers [112]. These infections have a serious consequence. According to estimates, between 2000 and 2030, these infections will likely result in 145 HCV, 261 HBV, and 736 HIV-related early deaths. The few studies that have been done in sub-Saharan Africa have shown that healthcare personnel are regularly exposed to occupational dangers that include biological, chemical, and physical [112]. The disproportionate burden that sub-Saharan Africa carries in comparison to wealthy nations is highlighted by the high frequency of HBV, HCV, and HIV among healthcare professionals who sustain sharp injuries. For instance, occupational exposure is responsible for 11.8% of HBV, 2.8 of HCV, and 5.1% of HIV infections in the Africa E sub-region (which includes Botswana, Congo, Malawi, South Africa, etc.). Contrast this with the America A sub-region (Canada, Cuba, and the United States), where occupational exposure is responsible for 0.51% of HBV, 1.6% of HCV, and 0.29% of HIV infections. Blood borne pathogens are more common in the general population, which helps to explain the increased incidence, but sub-Saharan Africa's subpar healthcare infrastructure is also a factor [112.] There are well-established guidelines to prevent exposure to occupational hazards, including blood and blood borne pathogens. These include educating healthcare workers on safer use of devices, procedures and management of exposures. Furthermore, the World Health Organization (WHO) has instructed governments to transition to the exclusive use of safety injection devices by 2020. While developed countries have heeded this recommendation, the vast majority of sub-Saharan African countries have failed to enact legislation to protect healthcare workers. Apart from provider behaviors that increase exposure to occupational hazards, system-level barriers increase the risk of exposure to hazards in the healthcare setting [113]. To avoid occupational risks, such as exposure to blood and bloodborne diseases, there are defined regulations. These include teaching healthcare professionals on how to utilize equipment, perform treatments, and monitor exposures. In addition, the WHO has given states instructions to switch over to using only safety injection devices by 2020. While industrialized nations have taken this advice to heart, the great majority of sub-Saharan African nations have not passed legislation to safeguard healthcare professionals. System-level obstacles raise the likelihood of exposure to hazards in the healthcare context in addition to provider practices that do the same [113]. The danger of exposure to blood borne pathogens and the development of avoidable illnesses is increased by unsafe working conditions in the healthcare industry, a lack of personal protective equipment (PPE), and a high provider-to-patient ratio. According to healthcare workers in four African nations (Cameroon, South Africa, Uganda, and Zimbabwe), the best four reasons for leaving developing nations are better pay, a safer working environment, poor living conditions, and a lack of facilities. The significant lack of healthcare workers in 57 countries, the majority of which are in Africa and Asia, was highlighted in the 2006 World Health Report Working Together for Health. The impact of workplace risks on the continent's critical scarcity of healthcare workers has negative effects on patient outcomes, productivity, and life expectancy. Policies to make the healthcare environment safer for healthcare workers can be informed by a better understanding of the prevalence of occupational hazards among healthcare professionals in sub-Saharan Africa. Therefore, the goal of this systematic analysis was to investigate how often healthcare professionals in sub-Saharan Africa are exposed to blood and blood borne diseases [113].

Knowledge and Attitude

Health care facilities (HCFs) are organizations that offer treatment services for the healthy, ill, and injured, including counseling, clinical, surgical, and/or psychiatric consultations and evaluations. HCFs are categorized as hazardous and high-risk work environments since they employ more than 59 million people worldwide and provide a wide range of services to consumers and patients. Similar to other high-risk workplaces, healthcare facilities are characterized by a high degree of hazard agent exposure, which poses a serious risk to the health and life of employees (HCWs). Risk is the likelihood that harm to "life, health, and or the environment" may result from a hazard, whereas hazards are intrinsic properties of a material, agent, source of energy, or circumstance that have the potential to cause negative results. In this context, workplace behaviors that have the potential to result in harm or illness are referred to as occupational risks. Workplace safety generally refers to the practice of protecting staff members' health and safety while on the job, regardless of their line of work. Occupational safety is the control of risks in the workplace to attain an acceptable level of risk. The high rates of related morbidity and mortality among exposed workers make occupational health and safety a crucial problem. About 400,000 new cases of occupational diseases are reported each year, and an estimated 100,000 people pass away from them. Due to their exposure to varied types and levels of workplace dangers, this has an impact on employees in a variety of occupations. The biggest risk of exposure to high-risk occupational hazards is seen in the farming, general contracting, steel, automobile, truck driving, and nursing sectors, according to studies. Oluwagbemi claims that over the past 30 years, HCFs in Nigeria have grown in size, sophistication, and diversity with difficulties maintaining the best practices and tools needed to carry out high-risk clinical treatments [122]. Protecting the health and wellbeing of front-line healthcare professionals (HCWs) is challenging for HCFs, but. HCWs may be exposed to risks while doing their statutory tasks that materially degrade their health and quality of life, with a cascading effect on their close relatives. Therefore, HCWs require protection from working dangers just as much as employees of other high-risk industries like mining or construction [122]. WHO (2017) categorized the risks in HCFs into physical, biological, mechanical, ergonomic, chemical, and psycho-social risks. Although they could be decreased or eliminated, previous research has revealed that occupational injuries and illnesses among HCWs rated among the highest of any industry. Blood-borne diseases, such as the Human Immunodeficiency Virus (HIV), Hepatitis B virus (HBV), and Hepatitis C virus (HCV), back and neck pain, burnout stress, allergic responses to latex materials, chemical spills, radiation exposure, and patient assault are among the main risks for HCWs. Inadequate staffing, an excessive workload, a lack of protective aids and equipment, negligence and carelessness on the part of healthcare workers, as well as failure to follow basic safety and hygiene guidelines are some of the factors that contribute to occupational illnesses and injuries in HCFs [10]. Because of these, the US Centers for Disease Control and Prevention (CDC) created standard precautions (SPs) to guard against handling infectious materials in HCFs and avoiding occupational exposures to them. It has been demonstrated that following the SP standards can reduce occupational diseases and injuries among HCWs working in HCFs. Physical, financial, and psychological harm to HCWs and their dependents are all effects of occupational illnesses and injuries. HCWs (medical doctors, nurses, and nursing assistants) in Nigeria are ill-equipped to deal with occupational dangers and suffer accidents or illnesses as a result while carrying out their jobs. The lack of adequate facilities with equipment that could improve best practices in underdeveloped nations exacerbates the vulnerability of the workers in HCFs. Therefore, occupational vulnerability of HCWs poses a challenge to the provision of high-quality healthcare in developing nations, particularly for physicians, nurses, and nursing assistants. The few research on occupational hazards among HCWs in underdeveloped nations tended to be more focused on certain job titles within the healthcare delivery system. However, this study evaluated the occupational risks and safety procedures among healthcare workers—medical doctors, nurses, and nursing assistants—whose job descriptions call for virtually daily direct patient contact in the majority of HCFs (MdNNA). This study determined the causes of occupational hazards and predisposing factors among the chosen HCWs in the Nigerian study area.

Should healthcare providers do safety cases

Public concern about patient safety is high. The findings of the public inquiry examining the shortcomings at the Mid Staffordshire NHS Foundation Trust have received extensive media coverage in the UK. According to the findings, between 2005 and 2009, up to 1200 people may have died prematurely as a result of subpar and frequently abhorrent standards of treatment. Evidence from numerous nations and healthcare systems reveals that people worldwide experience avoidable adverse effects Adverse events result in unnecessarily prolonged patient care needs and more bed days, as well as higher insurance and lawsuit expenses. They also have major financial repercussions.

To increase patient safety and lower the incidence of adverse events, healthcare organizations have been urged to take lessons from safety management in safety-critical industries For instance, the construction of a national incident reporting system (National Reporting and Learning System) in the English National Health Service (NHS) has benefited from lessons learnt about incident reporting in aviation [127]. Additionally, there are more and more examples of how risk is applied in the literature.

Manufacturers and operators of safety-critical systems, such as nuclear power plants and petrochemical facilities, must submit a safety case to the appropriate regulatory authority in the UK safety-critical industries. In these industries, safety cases offer a recognized method for proving and evaluating that a disciplined and successful risk management strategy has been implemented, and that the system that results can be considered with confidence as acceptably safe [127.] The safety case approach, however, has also come under fire, with some arguing that faulty safety case procedures were a major cause of accidents by encouraging a "tick-box" and too compliance-driven approach to safety. Additionally, studies indicate that there isn't enough proof to support their usefulness as a tool for regulatory control [128].

The safety case concept has attracted attention recently in the field of healthcare, particularly for health information technology and medical devices like infusion pumps [126]. However, there is little solid data on the contribution of safety cases to enhancing safety management procedures more generally in the healthcare industry [126.] Additionally, there isn't a lot of advice on using safety cases that isn't highly sector-specific and instead is based on lessons from other industries. Since healthcare safety management methods and the regulatory environment differ greatly from those in other safety-critical industries, this paucity of data and advice is especially problematic. Healthcare safety management is probably still primarily governed by a reactive mindset and a regulatory strategy that depends on regularly gathered outcome data (such as mortality rates). There is a concern that in such a culture and environment safety cases may be seen as just another regulatory tool for producing documents or as a replacement for proactive patient safety risk assessment. Are safety cases a possible threat to conscious safety management, a necessary evil, or, in the appropriate conditions, do they have the ability to positively contribute to the advancement of more organized and stringent safety management procedures in healthcare? Lessons learned from a study [129] that examined the use of safety cases in six safety-critical industries are presented in this publication (automotive, civil aviation, defense, nuclear, petrochemical and railways). The article examines the trends and factors influencing the adoption of safety cases in various sectors. The study then critically analyses obstacles, lessons, and requirements for the possible widespread and systematic growth of safety cases within the healthcare sector based on such a thorough, cross-industry review of safety case practices [131.]

The essay is set up as follows. The conceptual underpinning for safety situations is succinctly outlined in Section 2. Section 3 examines a survey of safety case procedures in six distinct businesses and draws conclusions for the adoption of safety cases from these findings. The growing application of safety scenarios in healthcare is reviewed briefly in Section 4. In Section 5, opportunities and obstacles for the implementation of safety cases in healthcare are discussed in light of the findings of the cross-industry analysis. The main conclusions and ramifications for research and practice are presented in Section 6.

Safety cases

In order to comply with many of the UK's current regulatory frameworks, makers and operators of safety-critical systems must show that they have implemented a detailed and organized procedure for proactively recognizing and managing the risks connected to their systems. With these methods, the regulator establishes the objectives, but the system creators and operators are in charge of proving that the objectives have been met. This gives them the freedom to make their case while taking into consideration the particular situation and any technological advancements. In the UK, safety cases are frequently used to carry out these obligations. Over the past 20 years, regulatory techniques have changed from being compliance-based to being more goal-based, leading to the current regulatory approach. Instead of proving that certain higher-level objectives have been achieved, producers and operators who operate under a regulatory system that is primarily prescriptive can only claim safety if they satisfy specific criteria and technical requirements set forth by the regulator. The compliance-based approach has come under fire for encouraging bureaucratic safety management procedures where dangers may not be fully recognized and for possibly impeding advancement in sectors of the economy that are driven by technological developments [132].

By giving system operators more authority and flexibility, the goal-based approach seeks to address the drawbacks of prescriptive regulatory frameworks.

The goal of a safety case is to present a well-structured argument that is supported by substantial evidence to show that a system is acceptably safe for a particular application in a particular situation. An argument that is based on risk and the supporting data are essential components of the safety case. This is meant to show that all risks connected to a specific system have been recognized, that suitable risk controls have been implemented, and that suitable procedures have been set up to monitor the efficiency.

As part of the entire safety evaluation or certification process, the reasoning and evidence in safety matters are then reviewed and contested, often by independent safety assessors. Although safety cases are typically private, some are made available to the public (for instance, the Safety Case Repository (Dependability Research Group University of Virginia). The literature also provides descriptions of developments in actual safety cases as well as advice on effective high-level arguments and argument techniques [130] (for example Companies employ safety cases as a way to give structure and rigor to their safety management systems since it is a recognized best practice in UK safety-critical industries) [130]. This is in keeping with the advice given by Lord Cullen in the incredibly influential Public Inquiry into the explosion of the Piper Alpha oil platform (The Honourable Lord Cullen, 1990). The paper emphasizes that the safety case's primary purpose should not be to satisfy regulatory obligations. The operators of safety-critical systems themselves should have assurance from the safety case that they have taken a methodical and thorough approach to making sure that their systems are safe (The Honourable Lord Cullen, 1990). Safety cases have drawn criticism because they are not a foolproof solution for effective safety management. In order to develop recommendations for the effective adoption of safety cases in other areas, such as healthcare, it is crucial to critically examine the lessons, criticisms, and obstacles of safety case practice. The variety and ongoing evaluation of research and teaching operations result in a number of special dangers. Technical, physical, chemical, or biological risks fall under this category. We describe a laboratory accident involving the chemical acryloyl chloride, its repercussions, safety measures, and the lesson we learnt from it. The liquid acryloyl chloride is extremely poisonous and flammable. After unintentionally ingesting acryloyl chloride, the victim had severe nausea and vomiting, severe headache, dizziness, fatigue, nasal bleeding, and chronic eye burning. Two separate harmful effects—nose bleeding and stomach ulcers—that the victim claimed to have experienced were not indicated in the SDS for acryloyl chloride. It may be desirable to start steroidal medication combined with symptomatic treatment right away to prevent further escalation of the effects of the acryloyl chloride accident. Researchers, postdoctoral fellows, principal investigators (PI), safety experts, organizations, occupational health nurses, doctors, and toxicologists will use the unintended repercussions and lessons learnt from this tragedy as a compass to steer clear of such incidents in the future.100

The Safety "Use Case": Co-Developing Chemical Information Management and Laboratory Safety Skills

2015 saw the publication of the most recent version of the ACS Guidelines and Evaluation Procedures for Bachelor's Degree Programs by the American Chemical Society's Committee on Professional Training

(CPT). (1) These recommendations detail six skill sets that undergraduate chemistry students ought to acquire. These are the sets:

1. Problem-Solving Capabilities

2. Information management and literary knowledge in chemistry

3. Skills for Laboratory Safety

4. Communication Capacity

5. Teamwork Skills

6. Ethics

We have reviewed these demands in order to create tools and resources to assist academic chemists in meeting these standards in our separate support roles as a chemical hygiene officer and chemistry librarian. Through this process, we have come to understand that information literacy skills specifically have a "use case" for safety abilities. The use case for laboratory chemical safety poses an intriguing issue because a comprehensive safety planning process includes a mixture of considerations unique to laboratories and organizational support services. For instance, lab-by-lab management of ventilation and personal protective equipment requirements is typical, whereas organizational management of waste disposal and emergency planning and response is typical. As a result, a comprehensive laboratory safety program requires the participation of a wide range of roles, including laboratory chemists and their supervisors, chemical educators and their students, environmental health and safety specialists, and chemical information specialists. These parties work together to create risk evaluations and management plans for chemical risks connected to laboratory procedures. But they tackle this work from various angles and with various vocabulary. As a result, the research and planning process for laboratory safety might pose major information literacy issues. Their professional literatures reflect these disparities.

In this article, we set up new chemical risk assessment and management tools into a cycle model that reflects the advantages and disadvantages of the knowledge at each level. This approach is based on the knowledge practices stated in the Association of College and Research Libraries' Framework for Information Literacy for Higher Education (ACRL). [3] The CPT's objective to include undergraduates in chemical research as "the most satisfying and educationally important component of an undergraduate chemistry degree" is consistent with the integration of information literacy and laboratory safety skills and instruments at the undergraduate level. We think that by employing the laboratory safety use case as an illustration of an information literate use of chemical data and information to promote problem-solving, communication, team building, and ethical abilities, the CPT's vision may be brought together into a coherent whole.

Laboratory safety and information literacy

In January 2009, a lab mishap involving the use of pyrophoric chemicals resulted in the death of a laboratory technician who worked in the Chemistry Department at UCLA 3 weeks after suffering severe burns. She had been employed for three months and had earned a chemistry bachelor's degree from Pomona College in May 2008, per the C&EN report on this incident. The university's response to the incident's legal charges. She was a "experienced chemist," and as such, it was reasonable to believe that she would be familiar with proper laboratory safety procedures, according to the University's answer to legal claims resulting from the incident. When California OSHA determined that this claim did not meet the legal criteria for workers who handle hazardous chemicals to get safety training, the institution and her supervisor were both charged with crimes. In particular, "What laboratory safety awareness and abilities should be anticipated to be delivered during an undergraduate chemical education" is one of the numerous considerations that this series of occurrences poses.

Chemists who examined the UCLA incident noticed that while there was information about handling pyrophoric compounds properly, it was dispersed over a number of sites. This laboratory did not collect and organize this safety information into an operating method, despite the fact that several chemistry commenters noted that this is typical in many academic research environments. The UCLA fire serves as a reminder of the need to improve academic chemistry's safety culture in terms of both information literacy and laboratory safety abilities. Because of this, we have been examining the relationships between different skill sets and have discovered numerous chances to combine them. Information literacy is actually the capacity to gather, critically evaluate, and then use information to methodically create and record a definite judgment. As a result, information literacy requires effort at the higher levels of Bloom's taxonomy, particularly the synthesis and evaluation skills. To create prudent operational strategies for carrying out the current laboratory job, laboratory safety planning demands methodical investigation and careful analysis. As a teaching opportunity that immediately connects into the information literacy skill set, laboratory chemical risk assessment practice is supported by emerging chemical information and management resources and risk assessment technologies. The strategic exploratory element of research is emphasized by the ACRL framework, which also outlines the essential ideas involved in formulating, researching, organizing, assessing, and summarizing investigations. We describe a decision-making procedure for chemical safety planning using these practices.[101]

Emergence Of Laboratory Safety Tools

Over the past two decades, there has been a significant evolution in the context of laboratory safety in chemical education and research. New demands have been made for broader laboratory safety education for chemists at both the graduate and undergraduate levels due to new scientific frontiers,[4] evolving laboratory technologies,[15] specific laboratory safety incidents,[16], and increasing emphasis on undergraduate laboratory research [4,17] The CPT guidance on laboratory safety was expanded in 2015 in response to these needs. Thankfully, recently developed safety tools can meet these demands.

Tool 1: Prudent behaviors and a safety culture

The relationship between two fundamental ideas, laboratory safety culture and sensible practices, is the primary tool for comprehending the context of laboratory safety. These ideas have changed over the past 20 years as a result of several laboratory accidents that have raised awareness of the need for safe chemical usage in academic laboratories on a national level. Since the middle of the 1980s, the phrase "safety culture" has gained popularity and been employed in a number of contexts. Since 2010, professional associations and scientific societies have published articles discussing the significance of enhancing the safety culture in academic laboratories. According to the CPT guidance, maintaining a culture of laboratory safety entails "...responsibility (that) goes beyond simply adhering with federal, state, and local regulations—it is about caring for the safety of fellow students, professors, and staff." It can be difficult to understand a "beyond compliance" approach to laboratory safety culture, nevertheless, in particular lab circumstances. This strategy entails, in plain terms, that government rules should serve as the minimum rather than the maximum for safety practices and that laboratory operations should be consistent with "prudent practices" found in both professional literature and legal requirements. What constitutes prudent procedures is outlined in the National Research Council paper Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards. The recommendations for laboratory-specific procedures are not included in this paper, though; in reality, laboratory work varies too much and evolves too quickly for this to be a useful strategy for a single publication. Institutional guidance, such as a local Chemical Hygiene Plan, emergency response plans, or institutional regulatory compliance plans, when these are available, can provide more explicit expectations about responsible procedures at a specific location. This institutional guidance takes into account the demands of local government agencies who are in charge of particular safety matters such fire code requirements, restrictions on waste disposal, and safety services offered at the institutional level. Although these guidelines are useful, they are not final for the following three reasons:

1. In this sense, "prudence" does not imply that safety procedures must account for every conceivable contingency; an unexpected event would be regarded as going beyond the bounds of prudent planning. As a result, depending on the specifics of each laboratory, the threshold for prudence may change. Planning for earthquakes, for instance, is regarded as being wise while working with hazardous chemicals in California but may not be in places without a major seismic history. To establish what constitutes responsible procedures in certain laboratories, it is required to analyze governmental rules, professional publications, and the chemical primary literature.
2. In this context, "laboratory scale" refers to laboratories as defined by the OSHA Lab Standard. This concept establishes crucial limitations on the work that should be regarded as falling under the umbrella of sensible practice. There are numerous chemical research settings that do not fit inside this criterion, so it is important to carefully assess whether a given process does so as part of the research planning process.
3. As interdisciplinary lab teams proliferate, it's critical to understand that there are major risks in the lab that go beyond chemicals. These include radiation worries, bodily dangers, equipment dangers, and biohazards. There are differing expectations for what is deemed appropriate in controlling these hazards compared to chemical issues for regulatory and cultural reasons. Understanding how different situations in a multidisciplinary research setting require different laboratory safety standards is related to both the teamwork and ethical competencies listed by CPT. Together, these elements necessitate comprehensive documenting of the evolution of safety procedures used; a cursory examination of a procedure's chemical components won't suffice to address many of the issues that occur when describing how caution is applied during chemical work in the laboratory. A classic information literacy task is using these various information sources efficiently.

Tool 2. The Global Harmonization System: Strengths and Weaknesses is a second tool.

The United Nations spearheaded an effort to create a worldwide standard for the classification and communication of chemical dangers after realizing the shortcomings of MSDSs mentioned above. The

Globally Harmonized System of Classification and Labeling of Chemicals was first published in 2003. (GHS). [26] In order to satisfy the need for consistent, clear identification of chemical dangers, this approach integrates technical and communication factors. This is achieved by giving precise scientific definitions for crucial phrases used to define chemical dangers and grouping them to promote an approachable hazard communication system. The GHS system's hazard classes offer a structure for arranging data on chemical safety into a more effective hazard communication system. Manufacturers in the US must offer GHS information to consumers who buy chemicals after 2015 via Safety Data Sheets (SDS), the replacement for the more conventional Material Safety Data Sheets. The GHS approach to chemical hazard communication represents a considerable advancement, but the new format still poses significant information literacy issues in the laboratory context, including the following:

• SDSs are structured around a particular, specific chemical, and the information they include (beyond raw hazard data, such as "wear personal protective equipment as required" is rather general and needs further interpretation when put to use.

• The GHS recommendations do not address changes in the amounts, concentrations, and chemical products that emerge during a laboratory procedure. • Most SDSs do not list hazardous interactions between chemicals during a specific process.

• The source of information is the chemical producer and supplier, whose interpretation of the GHS standards can vary depending on which information sources they consult. • Nonchemical risks, such as operating temperatures and pressures, are not taken into account by the system.

For these reasons, the GHS information alone does not offer sufficient direction for the routine conduct of laboratory research. To carefully organize chemical operations in the laboratory, a methodical approach to using this and other information is required.

Tool 3: The RAMP for Laboratory Safety

Using GHS data to support decision-making in laboratory practice necessitates extra research and analysis on chemical safety. The CPT safety standards outline the RAMP model as a uniform, portable, scalable, and sustainable way to manage safety data as laboratory work develops. The model, which was first presented in Hill and Finster, offers a conceptual framework for the safe administration of laboratory-scale chemical processes.

The RAMP mnemonic is spelled out in the safety skills used in the model:

- Recognize chemical dangers,
- Evaluate those risks,
- Reduce the risks associated with those risks, and
- Be ready for emergencies.

The laboratory safety use case's additional statutory and moral considerations have been added to this model. To emphasize the continuing nature of cautious measures as the process moves forward, we specifically revised "Minimize the risks" to "Manage safety." Additionally, we have included "Protect the Environment" to the model's step 'P' to cover "beyond compliance" issues such laboratory energy conservation and Green Chemistry potential, as well as compliance with emergency preparedness and waste disposal regulations. The "Lessons Learned" and "Safety Case" documentation components are also part of the system. These features acknowledge the researcher's ethical duty to disclose any safety-related aspects of their research. When familiarity with the procedures grows and/or the persons performing the work change, "backsliding" can be avoided by documenting the decision-making process throughout the entire cycle in a Safety Case. Safety lessons encourage safe replication of the work, which complements the scientific knowledge acquired through experimental study. Because of this, it would be great if these teachings were frequently presented in primary chemical literature. Laboratory safety is made cyclical by adding Lessons Learned and Safety Case documentation into the RAMP model, which informs the following iteration of the lab operation and offers a chance for improvement.

Tool 4: Laboratory Risk Assessment

The development of the GHS system is beneficial to the iRAMP process' Recognition stage. However, the hazards connected with the chemical process are the key factors in assessing the safe usage of hazardous chemicals. Beyond the dangers posed by the chemicals being utilized, the risks are established by the exposure of individuals to these dangers and the possible harm they may cause. These elements are taken into account during the assessment process to decide what constitutes reasonable practice for moving forward with the lab work. Fortunately, the GHS incorporates Signal Words into its hazard definitions to provide some support for determining the level of risk connected with the hazard of a specific chemical. To completely analyze chemical risks in the laboratory setting, further study is required due to the generic nature of the GHS categories, it is vital to note. There are several techniques for evaluating chemical hazards that take extra aspects of lab procedures and environments into account. The ACS Committee on Chemical Safety's 2015 publication Identifying and Evaluating Hazards in Research Laboratories, which goes into further depth on these analyses, is recommended for readers. This article offers advice on many risk assessment techniques that are suitable for laboratory work.

Tool 5 Measures for Safety Management

Managing safety in the iRAMP paradigm entails creating a hazard control system. The National Fire Protection Association's 2015 revisions to the Standard on Fire Protection for Laboratories Using Chemicals outline the requirements for such a system for teaching and instructional laboratories [30]. In order to manage safety in the research laboratory, Prudent Practices in the Laboratory offers both administrative and technical guidance. A systematic approach to safety management often consists of five categories. One of these components is changing the chemical used to reduce the risks it poses. This can be done by lowering the quantity or concentration of the chemicals used, switching out the reagents, solvents, or other compounds, or applying relevant Green Chemistry concepts. [31]

2. Finding engineering controls that can be used in laboratory environments and practices to reduce exposures These controls frequently take the form of local exhausts like fume hoods, correct storage of volatile chemicals, and overall ventilation of the lab area.

3. Instructing, supervising, and monitoring those who work in the lab. This includes identifying essential system components that could need the hazard control to be adjusted as well as ongoing monitoring of specific precautions relevant to the scheduled activity.

4. Assigning Personal Protective Equipment (PPE) that is suitable for the particular dangers present to reduce direct exposure This metric entails identifying the PPE categories that apply to each laboratory process step. Additionally, it addresses attire conventions like wearing long pants and closed-toed shoes. Specialized tools that simply shield the worker themselves, such a blast shield, can also be categorized under this heading.

5. The development of laboratory protocols that handle expected situations not covered in normal institutional emergency response plans, as well as efficient, continuing training of laboratory employees in how to apply these plans, are all parts of emergency planning and response. In most chemical laboratory settings, it would not be wise to rely solely on a fume hood, personal protective equipment, or worker training to handle threats. It is crucial to keep in mind that these elements work together as a safety system. There is no one formula that can be used to determine whether, for instance, certain PPE is necessary due to the interrelated and systematic structure of safety management activities. To create particular requirements for the safety management components, the iRAMP technique must be applied to laboratory procedures on a case-by-case basis.

Health, Safety and Environmental Risk Management In Laboratory Fields

Quantitative risk analysis aids in lowering the probability of undesirable events and minimizing the potential negative effects. Utilizing quantitative risk analysis (QRA) in process systems is challenging due to the random nature of component failures and event repercussions across different processes. The thousands of parts and stages that make up any process system make it incredibly difficult to gather the requisite quantitative data about every one of them Attempts to relate risk and uncertainty based on the dichotomy between aleatory and epistemic uncertainty might be summarized as follows, according to Olsson and Hillson: "risk is a measurable uncertainty and uncertainty is an immeasurable danger". As previously mentioned, the first stage in risk management is risk identification.

Each step is described as follows:

Threats to a project are identified and noted.

Analyses: Recognizes how these dangers to the project operate.

Prioritization: The threats are ranked in order of their potential impact.

Identifying potential preventive measures that lessen the impact of risk is known as mitigation.

Making a plan to use for major risks and implementing it before they materialize is known as planning. Measurement and control: Manage, restricts, and tracks the impact of risks to enable the project's objectives to be met. In order to execute risk ranking and filtering, the entire risk is broken down into risk components, which are then assessed for their unique contributions to the overall risk. The primary concern of the management of health, safety, and the environment is this minimization of human risk.

Each step is described as follows:

Risk, or the exposure to risk, is a process that produces equivocal findings in almost all scientific disciplines. Risk, or more correctly "process," however, is always associated with inventions that alter the path of human history. The majority of humankind's scientific and technological advancements are a direct outcome of its "spirit of risk taking". The current study was carried out in a Tehran-based academic training facility that was initially built to serve postgraduate students. The US Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration have primarily used conventional methodologies for risk assessment studies that concentrate on important factors such chemical exposure levels, type of exposure, and duration. Additionally, investigations on the risks brought on by laboratory hazards have lately mostly centered on qualitative characterization of substances. A team led by Sayre with backgrounds in chemistry, engineering, toxicology, exposure assessment, and risk assessment carried out the investigation. The behavior and potential hazards of 100 various forms of nonmaterial were the main subjects of Sayre's study. Risk management was crucial since exposure to such elements by workers at the research facility under study resulted in the control and modification of their workplace. Another study by Musee that looked at nanomaterial risk evaluation used qualitative and semi-quantitative methodologies to evaluate issues in risk assessment and management. The survey results demonstrated the need for chemical and nonmaterial profile analysis as part of the risk assessment process. On the other hand, the inquiry was undertaken with a focus on environmental issues in addition to non-material quality and safety oversight, including organization senior manager control. Musee's subsequent research provided more detail on the techniques investigated for limiting the dangers associated with chemicals. The aforementioned investigation identified and offered control priorities for suspected causes of the studied chemicals as well as control and administrative solutions. The risk assessment method was utilized in the current study to examine the equipment, procedures, circumstances, and threats connected to the workplace. Under the heading of machinery risk, the health and safety risk assessment technique were applied. The employed method was sanctioned as an international standard ISO14121 based on the requirements of European standards.

The procedures involved in education and research nowadays are more complex and ambiguous. In turn, regulations and rules impose more stringent obligations

A Canadian Viewpoint on Safety Compliance And Culture In University Laboratories.

Laboratories are inherently risky places to work. In fact, there have been a number of recorded events from university laboratories located in the United States and around the world, including fatalities. These laboratory mishaps have frequently been blamed on weak safety culture and a lack of safety compliance.

Oddly, no significant incidence appears to have been reported from a Canadian university lab. As a result, this pilot study's objective was to investigate the safety culture and degree of compliance in a medium-sized Canadian institution. This was done by giving participants access to an online survey, some of which were adapted from 2017 international safety culture research. The findings suggested that there may be a discrepancy between how safety is perceived. The findings suggested that there may be a disconnect between how safety is managed and perceived at the participating institution. For instance, while 90% of the participants reported that safety is essential to them, only 40% said that they always wear their personal protection equipment when performing lab work, 27% said they do not undertake any kind of risk assessment prior to lab work, and 9% said they had no safety training. Additionally, although 88% of respondents said that safety is a top priority in their lab, 39% thought that safety might be improved. These findings imply that this Canadian institution's laboratories not only struggle with safety compliance, but also lack a robust and supportive safety culture. Overall, these findings provide more proof that poor safety compliance and safety culture in university labs are widespread issues that require immediate addressing.

Academic lab safety research

In academic laboratories across the globe, there have been a number of high-profile mishaps over the past ten years that have resulted in serious injuries and fatalities. The demands for reflection and reexamination of the academic discipline's strategy for safety research and policy are frequent responses to these tragedies. The research of academic lab safety, however, is still in its infancy, and the crucial information regarding shifts in safety attitudes and behaviors has not been acquired. This Review article critically analyzes the current state of academic chemical safety research from a multifaceted perspective, including research on the frequency of lab accidents, factors that contribute to lab accidents, the current state of safety training research, and the cultural barriers to conducting safety research and implementing safer lab practices. The Review ends by outlining the research issues that must be resolved in order to reduce potential future serious academic laboratory accidents and highlighting the necessity of devoted leadership from our research institutions.

Biosafety and Biosecurity Measures

Here, we investigated laboratory-acquired infections (LAIs) and the biological dangers they provide to human health in order to establish a solid evidentiary base on which to address biosafety/biosecurity and biocontainment concerns. A wide range of pathogenic agents, including bacteria, fungi, viruses, parasites, and genetically modified organisms, have been described over the past few years and have raised significant concerns due to the serious biological and ecological threats they pose. Additionally, the biosafety and biosecurity agenda to avoid LAIs includes the emergence and/or re-emergence of life-threatening diseases as a top priority. The most common causes of LAIs were found to be *Brucella spp., Mycobacterium tuberculosis, Salmonella spp., Shigella spp., Rickettsia spp.,* and *Neisseria meningitidis,* however the exact infection risk following an exposure is still unknown. Likewise, hepatitis and the human immunodeficiency virus (HIV). The majority of viral and fungal-associated LAIs are caused by dimorphic fungi, as well as the hepatitis B (HBV) and C viruses (HCV). In this situation, it is necessary for clinical laboratories in general and microbiology, mycology, bacteriology, and virology-oriented laboratories in particular to implement the proper biosafety and/or biosecurity measures to protect laboratory workers and the working environment from exposure to potentially dangerous substances or organisms. To get a sufficient understanding of how to manage biologically hazardous materials according to internationally recognized procedures, laboratory staff education and training are essential. Furthermore, workshops for lab personnel should be planned to inform them of the epidemiology, pathogenicity, and human vulnerability to LAIs. In this manner, a number of risks to health that arise from biological. By correctly implementing nationally and internationally certified protocols, which include proper microbiological practices, containment devices/apparatus, adequate facilities or resources, protective barriers, and specialized education and training of laboratory staffs, hazardous materials can be reduced or eliminated and controlled. The current work uses appropriate examples to show the major problem of LAIs and associated hazards. Also covered are potential preventive measures to deal with a variety of causal causes. In this regard, the scientific community and researchers may profit from the knowledge gained from earlier mistakes to foresee present issues.

Medical laboratory safety management

Any medical laboratory's success depends on lab safety, which is crucial. Hazards from the biological, chemical, radioactive, fire, and electrical domains have an impact on professional biosafety measures. Using personal protective equipment (PPE) incorrectly or not at all, not adhering to a chemical hygiene plan (CHP) that is appropriate for the task, using the wrong biological safety cabinets (BSCs), and potential technician exposure are the most frequent hazards to laboratory safety. Scientists conducted their studies in the early days of laboratory research utilizing methods that we would probably raise an eyebrow at today. Unfortunately, as a result of poor working conditions, some scientists were ill and, in some cases, passed away from illnesses they contracted while working in the laboratory. Out of 5,000 replies to a survey sent to laboratory professionals, Sulkin and Pike previously found 1,342 lab-related infections (LAIs) with 39 fatalities. 1 They found that *Brucella spp., Mycobacterium TB, Francisella tularemia*, and *Salmonella typhi* were responsible for 72% of the bacterial causes of LAIs. Not all of the diseases affected scientists; some also affected janitors, students, and animal caregivers. In 2007, the Centers for Disease Control and Prevention reported 916 potential exposures that could have led to LAIs and found that larger inpatient institutions with more than 200 beds had a higher risk of exposure for lab staff than smaller clinics.

Protecting scientists

The BSC has developed into one of the most efficient primary safety devices currently being used in laboratories, protecting both the worker and the product from which they are working. When Robert Koch created the first biocontainment device at the turn of the 20th century as a result of his realization that germs could be floating in the air, the necessity to safeguard scientists and other clinical laboratory personnel started to take shape. [3] The first dedicated device—now known as a BSC—was first described in 1943, and it vented exhaust air through a furnace that was used to sterilize the air. After being created as part of the Manhattan Project, the high efficiency particulate air (HEPA) filter later significantly improved the BSC's ability to maintain safety. Stainless steel structure, a glass sash, and many other features found on modern BSCs are just a few examples of how the designs and safety capabilities of the BSC and HEPA filter have continued to advance. The use of PPE, which is required in clinical laboratory settings, is another important aspect of managing employee safety. The most important thing is to be aware of the environment you are exposed to, whether you are taking a patient's blood sample or processing blood or other bodily samples. You might not need to worry as much about PPE if you are a technician typing quality control or findings from a finished cross match into a computer. But what if the technician is utilizing a staff-shared computer in the main laboratory space? For instance, "the usage of personal protective equipment (PPE) and compliance to the code of conduct" were the subjects of a 2014 study on safety measure compliance. 96.3 percent of those surveyed said it was crucial to use gloves when handling human samples. Only 38.7 percent of respondents indicated always, 27.2 percent often, and 32.7 percent occasionally when asked if they wear gloves as part of their everyday routine. "Lack of habit" (18.4%) and "They interfere with my work" were the most often selected justifications for not wearing gloves (32.3 percent). In addition, 75.1 percent of respondents to the question "I wash my hands before and/or after using gloves" (4), 16.1 percent said they did so frequently, 7.8 percent said they did it occasionally, and 0.9 percent said they never did so. Medical laboratory employees and physicians use PPE differently, according to 2014 research evaluating the normative understanding of blood-borne pathogen precautions (MLS). While 67.6 percent of MLS and 76.2 percent of physicians who were surveyed reported using personal protective equipment (PPE), 100% of MLS and 35 percent of physicians reported having general understanding of basic precautions.

Risk Assessment

For workers working in medical laboratories and research centers, training and compliance with PPE requirements are standards. The same PPE criteria won't always be necessary; PPE can only be fully effective when utilized effectively under the required circumstances. 6 Staff can guarantee that hazards and exposure risks are minimized in the clinical laboratory by implementing risk assessments for every procedure carried out there. Usually, risk assessments are carried out by creating a spreadsheet that includes both the main task and any necessary subtasks. This worksheet is designed to determine risks and gauge how risky a task is. Then, a laboratorian can make sure that risks are reduced and that the right PPE is used. Of course, depending on the task at hand, different PPE may be required. If you are working on a computer in an office that is never used for human samples, you might not need a lab coat. Would you wear PPE if you were going to a clinic to help collect bone marrow spicules from a bone marrow biopsy or aspiration? Of course, if the technique being performed requires it, you would put on gloves, a lab coat, eye protection, and more PPE. What if you are going to take a patient's blood and you see that they are wearing a face mask? When the occasion calls for it, it is proper for professionals to put on the required PPE. Both the laboratorian risk and the patient's time and suffering are reduced by taking the extra step to put on PPE rather than thinking it's not necessary. The installation of biosafety programs like a CHP is essential to the patient and laboratory staff's safety, just as it is crucial for clinical laboratories to provide excellent customer service. Chemicals are one of the most hazardous elements in the medical laboratory. The necessary components of a laboratory CHP are listed in the Occupational Safety and Health Administration (OSHA) fact page. 6 The OSHA laboratory safety chemical hygiene plan identifies the following essential CHP components; however, it does not address every potential contingency:

- Standard operating procedures that take health and safety into account
- Use of STET and hygiene procedures as needed
- Information must be given to lab employees working with hazardous compounds Requirement that fume hoods and other protective equipment are in good working order
- Conditions in which a method or activity is examined and approved before being implemented Designation of the staff in charge of implementing the CHP

The basic goal of the CHP is to identify risks for laboratory personnel, create standard operating procedures that eliminate or mitigate those risks, name a person in charge of overseeing this process, and outline additional protective measures while working in a more dangerous setting. This strategy aims to keep up with the necessary instruction and process oversight. As new procedures and methods are deployed, risks for laboratory workers are always changing. To maintain the CHP and update it as necessary, a key trainer must be identified. Without proper supervision of this process, you can wind up with a plan that outlines the methods for analyzers used several years ago, which is unacceptable. The testing capacities of many laboratories are comparable, but some procedures need more specific biosafety equipment, like a fume hood. A BSC is designed to protect the worker and is more frequently used in conjunction with protection from infectious diseases or poisons, whereas a fume hood is classed as a ventilated enclosure to eliminate pollutants. Depending on the working environment, a laboratory fume hood might be thought of as the lab employees' primary form of protection. What if your lab has nearly the same capacity or test load as other hospitals in the area, but your blood bank prepares irradiated goods for all the other labs in the region? These are elements to take into account when creating a strong CHP for your workspace. The implementation of biosafety measures is crucial for ensuring the security of the laboratory test floor and safeguarding the staff. The discipline of laboratory testing has benefited from the use of BSCs and HEPA filters in terms of efficiency and safety. Your protection and the protection of your personnel is guaranteed by the proper use of PPE based on strong risk management principles. The obstacles faced by medical laboratory employees are inherent in their line of work. However, a secure, productive atmosphere enables people to face these difficulties head-on with the application of proper biosafety measures.

Safety behavior among medical laboratory workers in private sector

The purpose of this study was to ascertain the link between the work safety scale (WSS) and safety behavior compliance among private sector medical laboratory personnel. The five elements of WSS, created by Hayes et al. in 1998, is a scale that measures employees' perceptions of workplace safety. Employee attitudes and behavior toward safety-related tasks are referred to as safety behavior. 119 respondents from private medical labs in Shah Alam, Klang, and Petaling Jaya, Selangor, participated in the study. Data was gathered through a cross-sectional study and a survey questionnaire. The questionnaire, which assesses occupational safety, coworker safety, supervisor safety, management safety practices, satisfaction with safety programs, and compliance with safety behavior, is adapted from Hayes et al. (2017) . every piece of information. Descriptive analysis, reliability testing, Pearson correlation testing, and multiple regression testing were all used to assess all the study data. The results demonstrate a positive correlation between compliance with safety behavior and job safety, supervisor safety, and coworker safety. In contrast, there was no significant correlation between management safety procedures and program satisfaction with regard to the dependent variable. When it comes to predicting compliance of safety behavior among medical laboratory personnel, job safety and supervisor safety have the strongest correlation with each other. The findings of this study may provide further insight into how medical laboratories operating in the private sector can enhance their safety management and safety procedures to provide a safe and healthy working environment.

Biosafety and biosecurity as essential pillars of international health security

When working with potentially infectious microorganisms and other biological hazards, biosafety refers to the application of laboratory practices and procedures, specific construction features of laboratory facilities, safety equipment, and appropriate occupational health programs. Biosafety is an adjunct to biosecurity. These precautions are intended to lessen the risk of exposure to potentially infectious pathogens and other biological hazards for laboratory workers, the general public, agriculture, and the environment. In recent years, attention has also begun to focus increasingly on laboratory-acquired illnesses (LAIs), particularly with reference to high-containment (biosafety level 3, or BSL-3) and maximum-containment (BSL-4) laboratories. Animal facilities, clinical labs, and research labs can all get LAIs, and it's not always clear whether the infection originated in the lab or in the neighborhood. In addition, LAIs also pose a serious public health risk since an infected laboratory worker could spread the disease to his coworkers, family, or the entire community.

Inadequate staff training increases the possibility of a laboratory acquired infection (LAI) or other biological accident. It may also contribute to inefficient pathogen accounting, storage, and transportation, which in turn may contribute to the unauthorized acquisition of biological agents by terrorists or would-be bio criminals. The implementation of international instruments for nonproliferation (such as the Biological Weapons Convention and United Nations Security Council Resolution 1540) and public health (such as the International Biological Weapons Convention) is essential because there is no single technology or procedure that could be used to prevent or deter the use of biological agents as weapons. The implementation of international instruments for nonproliferation and public health, such as the International Health Relations, summarized in Figure 1, as well as the establishment of regional and international partnerships in countering biological weapons are necessary because there is no single technology or process that could be used to prevent or deter the use of biological agents as weapons. Biosafety and biosecurity are the cornerstones of the global health security because they go beyond specific country issues and connect public health and security. This essay thoroughly examines each of these international agreements before presenting. This essay thoroughly examines each of these international agreements before demonstrating how Georgia uses them to advance biosafety and biosecurity.

Table 2.1 Biosafety and biosecurity under the International Health Regulations

	WHO International Health Regulations (2005)	UN Security Council Resolution 1540 (2004)	Biological Weapons Convention (1972)
Applicability:	All 192 UN Member States	All 192 UN Member States	163 States Parties
Purpose:	"to prevent, protect, protect against, control and provide a public health response to the international spread of disease…"	To prohibit **non-State actors** from developing, acquiring, manufacturing, possessing, transporting, transferring or using nuclear, chemical or biological weapons and their delivery systems.	To prohibit the development, production, acquisition, transfer, stockpiling and use of biological and toxin weapons
Requirements:	8 core capacities "to detect, assess, notify, and report events" [Laboratory core capacity includes biosafety / biosecurity]	Domestic controls to prevent the proliferation of nuclear, chemical and biological weapons, their means of delivery, and related materials	Any necessary measures to prohibit and prevent the development, production, stockpiling, acquisition, retention, transfer or use of biological weapons
Entry into force:	15 June 2007	28 April 2004	26 March 1975
Mandated reporting / where / when:	Status of implementation / WHO/"*As soon as possible but no later than five years from entry into force …*"	Status of implementation / 1540 Committee / "*without delay*"	None* "CBM voluntary reporting/ BWC ISU/ annually by 04/15

Biosafety / Biosecurity

The 58th World Health Assembly (WHA) updated and approved the International Health Regulations (IHR), a binding international pact intended to stop the spread of disease, on May 23, 2005. The IHR (2017) was created with the intention of "preventing, protecting against, controlling, and providing a public health response to the international spread of disease in ways that are commensurate with and limited to public health risks, and which avoid unnecessary interference with international traffic and trade." The revised IHR offer the international community new opportunities to improve public health capacities and work with other nations and the World Health Organization. They apply to diseases (including those with new and unknown causes), regardless of origin or source, that cause significant harm to humans (WHO). States Parties must comply with the core capacity criteria as soon as possible but no later than five years after the IHR (2017) enters into force, which took place in 2007. States Parties have two years as of June 15, 2007, to evaluate their national structures and resources and create national action plans. As of June 15, 2009, States Parties have three years to satisfy the core capacity requirements. The revised IHR offer the international community new opportunities to improve public health capacities and work with other nations and the World Health Organization. They apply to diseases (including those with new and unknown causes), regardless of origin or source, that cause significant harm to humans (WHO). States Parties must comply with the core capacity criteria as soon as possible but no later than five years after the IHR (2017) enters into force, which took place in 2007. States Parties have two years as of June 15, 2007, to evaluate their national structures and resources and create national action plans. States Parties have three years starting on June 15, 2009, to build the necessary structures, resources, and national action plans. Core capacity number eight, referred to as the laboratory core capacity, refers to those laboratory quality services that depend on verbal and written communication, specimen collection and transportation, financial resources, best practices for biosafety and biosecurity, trained personnel, suitable infrastructure, suitable equipment and reagents, and the provision of trustworthy results. In accordance with Article 54.1 of the Regulations, the WHO also created a framework for States Parties to use in tracking the growth of the eight core capacities (through assessment and implementation). This framework includes a list of indicators that can be used to better target WHO and Partner initiatives. Through a feedback mechanism, these indicators are also intended to guide strategic planning by identifying areas that need improvement. The framework specifically offers: I a group of 20 global indicators for tracking the growth of IHR core capacities for annual reporting to the WHA by all States Parties (mandatory for all); and ii) an additional 10 indicators for tracking the thorough growth, bolstering, and maintenance of States Parties' IHR core capacities.

Good Microbiological Practice and Procedure (GMPP)

It's critical to understand that GMPP may be the most significant risk control tool to be included as a fundamental need. A collection of standard operating procedures, also known as a code of practice, that is applicable to all kinds of biological agent-related activities is known as GMPP. This covers both general conduct, best practices, and technical processes that must be followed consistently and uniformly throughout the laboratory (Wurtz et al., 2017). The application of standardized GMPP serves to safeguard community members from disease, avoid environmental pollution, and provide product protection for work involving the currently in use biological agents (Wurtz et al., 2017). GMPP are the most important risk control measures because it has been discovered that human error, subpar laboratory practices, and incorrect equipment use are the main contributors to laboratory injuries and infections (Kimman et al., 2018, Pedrosa et al., 2017, Wurtz et al., 2017, Siengsanan-Lamont et al., 2018). To ensure safe working procedures, laboratory staff must be trained in and skilled in GMPP. Students studying biological, veterinary, and medical sciences should receive academic training in GMPP, and it should be included in the curriculum at all levels of education. For tasks, such as those outlined in sections 4 and 5, where higher risks were identified during the risk assessment, additional operational practices and procedures might be necessary. But GMPP will always be relevant (Kimman et al., 2017, Pedrosa et al., 2017, Wurtz et al., 2017, Siengsanan-Lamont et al., 2018). General behaviors, best practices, and technical procedures (such aseptic techniques) are all parts of the GMPP, and they work together to safeguard laboratory staff as well as the samples themselves from exposure to and/or release of biological agents (Kimman et al., 2017, Pedrosa et al., 2017, Wurtz et al., 2017, Siengsanan-Lamont et al., 2018).

Best Practice

The term "best practice" refers to actions that must be taken in order to provide safe working conditions and reduce biological risks (Kimman et al., 2017, Pedrosa et al., 2017, Wurtz et al., 2017, Siengsanan-Lamont et al., 2018).

Below are some illustrations of excellent practices for laboratories.

Never keep food, beverages, or personal belongings like bags and coats in the lab. Eating, drinking, smoking, and using cosmetics are only allowed to be done outside of the lab. Never, regardless of whether gloves are worn or not, put anything in your mouth while in the lab, including gum, pens, or pencils. Hands should be thoroughly washed, preferably with warm water and soap, before leaving the lab after handling biological material or animals, or if hands are known or suspected to be infected. ensuring that open flames or heat sources are never left unattended, close to flammable materials. Before entering the lab, make sure any cuts or skin breaks are covered. Before entering the lab, make sure there are enough supplies of lab supplies and consumables, including reagents, personal protective equipment (PPE), and disinfectants, and that these items are appropriate for the activities anticipated to ensuring that supplies are kept in a secure location and in accordance with storage guidelines to prevent mishaps and incidents like spills, trips, and falls. Ensuringhat all biological agents, chemical substances, and radioactive material are properly labeled. utilizing barriers (such plastic covers) to protect written documents from contamination, especially those that may need to be taken out of the lab. ensuring the task is completed with carefully and without rushing.

Avoid Working While Worn Out.

Keeping the workspace organized, spotless, and devoid of things and objects that are not necessary to preventing the wearing of earbuds, which might distract workers and block the sound of equipment or facility alarms. Putting any jewelry that might rip gloves, be readily contaminated, or create a fire hazard under cover or taking it off. If you frequently wear jewelry or eyewear, you should think about cleaning and decontaminating them. avoiding utilizing portable electronics (such as mobile phones, tablets, computers, flash drives, memory sticks, cameras, or other portable devices, including those used for DNA/RNA sequencing) until absolutely necessary for the lab processes being carried out. storing portable electronics in locations where they can't readily get contaminated or operate as a threat. When being in close proximity to biological agents is unavoidable, make sure the equipment is either physically covered or decontaminated before leaving the lab (Kimman et al., 2017, Pedrosa et al., 2017, Wurtz et al., 2017, Siengsanan-Lamont et al., 2018).

Technical Procedures

Technical procedures are a unique subset of GMPP that are directly related to risk control through safe laboratory practices. When properly carried out, these technical procedures enable work to be done in a manner that minimizes the likelihood of cross contamination (i.e., contamination of other specimens, previously sterile substances or objects, as well as surface contamination), and they also aid in preventing exposure of the laboratory staff to biological agents. (WHO, 2020).

The following steps assist in preventing some biosafety problems;

Avoiding Inhalation of Biological Agents

when manipulating specimens, using effective practices to reduce the development of aerosols and droplets. This includes avoiding violent mixing, flicking open tubes recklessly, and forcing contents from pipette tips into liquids. When combining using pipette tips, this must be done carefully and slowly. Before opening, combine tubes, briefly centrifuge them to assist dislodge any liqu id from the cap. (WHO, 2020). A direct introduction of loops or other similar instruments into an open heat source (flame) should be avoided as this could result in the spattering of infectious material. Use transfer loops that are disposable and don't need to be sterile wherever possible. Metal transfer loops can also be sterilized using an enclosed electric micro incinerator. (WHO, 2020).

Avoiding Ingestion of Biological Agents and Contact With Skin And Eyes

If handling specimens known to contain or reasonably anticipated to contain biological agents, always wear disposable gloves. It is forbidden to reuse disposable gloves. avoiding making facial contact with gloved hands. washing hands and removing gloves aseptically after use, as directed in the monograph on personal protective equipment (WHO, 2020). protecting the lips, eyes, and face when performing any task where splashes could happen, such as when combining disinfectant solutions. hair is secured to avoid contamination. treating any skin that has been damaged appropriately. preventing oral pipetting.

Avoiding Injection of Biological Agents

Any glassware should be replaced with plastic wherever possible.

If glassware must be used, make sure to inspect it frequently for integrity and toss anything that is broken, cracked, or chipped. To handle ampoules safely, use ampoule openers. employing blunt syringe needles, substitutes, or specially designed sharp safety measures to reduce the risk associated with using syringes or needles. But be careful that if handled improperly, sharp safety objects can also be dangerous. Never substitute syringes with needles for pipetting tools. Never remove needles, clip caps, or re-cap disposable syringes. disposing of any sharp objects (such as needles, needles paired with syringes, knives, and broken glass) in containers with sealed lids that are puncture-proof or puncture-resistant. Disposal containers must be impermeable to punctures, must not be filled to the brim (no more than three quarters full), must never be reused, and must not be thrown away in landfills. (WHO, 2020).

Preventing Dispersal of Biological Agents

Specimens and cultures should be discarded in leak-proof containers with the tops securely fastened before being disposed of in designated trash containers. Placing trash cans—preferably unbreakable ones (made of metal or plastic)—at each desk. Removing waste from containers on a regular basis and properly disposing of it. Ensuring that all trash is correctly labeled. opening tubes with a pad or gauze that has been dipped in disinfectant. using a suitable disinfectant to clean work surfaces after work operations and if something is spilled. When disinfectants are employed, they must be effective against the agents being handled and must be left in contact with waste materials for the necessary amount of time, depending on the disinfectant being used. (WHO, 2020).

Personnel Competence and Training

The greatest precautions can be compromised by human error and insufficient technical proficiency. Therefore, the prevention of laboratory-associated illnesses and/or other accidents depends on competent and safety-conscious laboratory employees who are knowledgeable on how to identify and control laboratory risks. (WHO, 2020).

Workplace Safety in Health Care

Perspective

The hazards that patients encounter when receiving medical care have been brought to light by the patient safety movement. But more significantly, risks also exist for workers. Although there is ongoing discussion about whether worker safety should be included in the patient safety movement, many organizations, such as the National Patient Safety Foundation. This article will concentrate on some of the more recent concepts of workplace safety that came from our overall considerations of patient safety and improvement. It outlines a repeatable procedure and framework that, in our opinion, can increase safety in a number of healthcare environments. The duty to keep the workforce safe falls on both the employer and the employee. For instance, it is the employee's responsibility to wear personal protection equipment (PPE) when performing work that management has classified as requiring it, even though management provides

PPE like as safety glasses to keep debris and chemical splashes away from the eyes. More generally, management must create thorough work instructions that explicitly spell out how tasks should be carried out in order to avoid quality and safety failures; the employee is then accountable for adhering to these guidelines. Additionally, management is in charge of creating a safe working environment where, for instance, workers may quickly find an eyewash station to wipe their eyes in case of a splash of caustic liquid or securely exit the work area in case of fire. Workplace risks abound, including less evident ones such accidents from passing suture needles in operating rooms (OR), musculoskeletal injuries from lifting heavy tool kits in central processing and the OR, and injuries from moving obese patients. The risks of working in an OR are particularly extensive and include concussions and trip injuries brought on by electrical lines on the floors and various monitors on booms. When there are so many potential hazards, how can management maintain a safe workplace? A team at Beth Israel Deaconess Medical Center integrated specific manufacturing and continuous improvement tools and methods in 2013 to create a strategy for locating, prioritizing, and reducing hazards in the medical setting. We feel that others could use this method when it is executed by cross-functional teams made up of those who perform the task, their supervisors, and employee health and safety specialists. Here is a suggested course of action.

Getting Going

Continuous improvement (also known as Lean) principles were put into practice prior to the meetings of these Job Safety Behavioral Observation teams to assist assure their success. The frontline staff and their managers collaborated to draft a team charter as the first stage. Drafting a strong charter that precisely states the following takes just one hour.

The present injury rate and the need to lower it:

- The burning platform a target for reducing injuries as measured by days missed from work due to accidents at work; a 20% decrease is a reasonable target.
- Suggestions for action (as outlined in this article)
- Membership:
- Manager of the Department
- Co-Leader: A representative of the Department of Health and Safety
- a supervisor or two, along with a few employees

Lean Thinking

Lean process improvement teams take the time to fully understand issues before moving quickly to address them. Similar to this, efforts to reduce staff injury started their analysis phase by interviewing those who perform the work (the complete staff, not just the staff members on the team) about how they get hurt. It's crucial to be aware of situations that can result in harm, such a wet floor that can cause slips and falls. Understanding behavior is equally as crucial as or perhaps more so. Why did the staff fail to seek assistance before transporting the obese patient? Was the OR under any time constraints that required it to continue alone? Employees were the only ones who could provide information for the OR Job Safety Behavioral Observation.

Formal observations help the team to comprehend things more thoroughly. We used OR staff meetings to update all of our stakeholders on the status of our work as it developed.

Official Remarks

Never starting from scratch and paying attention to what is going on around you are other continuous improvement tenets. The Job Safety Behavioral Observation approach for the healthcare sector makes use of techniques and procedures that are ubiquitous in business but have never been used in the sector. For instance, the observation tool we used is generally accessible; we only made a few minor changes to address dangers specific to the health care industry, like surgical smoke.

Workplace Safety Analysis

The Job Safety Analysis was another technique we adapted from the business world. By demanding the identification of hazards for each process stage and a means of eliminating them, this tool permits a thorough investigation of a dangerous process. As an illustration, the Job Safety Analysis was used by our OR Job Safety Behavioral Observation team to anticipate an injury before it happened. The nurse must take away the bed end for some GYN procedures that call for lithotomy. A 25-pound conventional bed end must be pulled firmly while the nurse is in an awkward position to do this. We discovered a lightweight bed end that completely avoided this risk after identifying it (Table). Sadly, as we had anticipated, a nurse was hurt while we were waiting for the bed ends to come from the seller. No one has used the lightweight bed ends since they were placed. Since the installation of the lightweight bed ends, no one has suffered a similar injury.

Eliminating Risks

Teams from Job Safety Behavioral Observation move on to minimize the dangers after the analysis phase of these projects is complete. In each of the four sectors (OR, Central Processing, Environmental Services, and Food Services) where we have established Job Safety Behavioral Observation teams, we have discovered various dangers. Here are a few instances of risks that were found and removed in the OR. There are further examples on a chart here. Revised Kit Pick Process: We noticed that five kits were typically selected and brought to the operating room (OR) for total hip surgeries. After talking to the surgeons who were going to execute this treatment, we altered the selection procedure so that only two of the five kits were regularly brought into the operating room. The other three kits will be transported up to the OR from Central Processing if a surgeon needs one or more of them. The OR and Central Processing personnel lifts 34 kg less every case as a result of this process modification, reducing their risk of musculoskeletal injuries. Implemented Use of Cord Covers: To avoid people from tripping over the electrical wires on the OR floor, the cords were covered with a visibly bright orange material.

In charge of the work

Job Safety Behavioral Observation teams continue to meet every other week to discuss new approaches to remove risks, go over work done since the last meeting, and plan new actions to eliminate hazards after finishing their analyses and putting some improvements into place. The occurrence rates in each area have decreased gradually but steadily. At the beginning of each year, our job safety teams renew their charters, setting new objectives and focusing on particular hazards.

Scorecard for Performance

Performance scorecards are used by process improvement teams to track goals' progress. A performance scorecard, which utilizes the total number of days missed from work as the metric, offered an excellent approach to gauge advancement. We were able to illustrate our development in a way that informed our work and motivated others, including the leadership of the health system, by showcasing both the prior and current year's performance. Only by transforming the safety culture to one in which employees think that all incidents are preventable and that everyone plays a part can workplace safety be improved in a real and sustainable way. Our experience has demonstrated that putting in place Job Safety Behavioral Observation teams and using a solid, repeatable procedure can enhance the workplace's safety culture and lead to fewer injuries.

Knowledge, Attitudes and Perceptions of Occupational Hazards and Safety Practices

Health care facilities (HCFs) are organizations that offer treatment services for the healthy, ill, and injured, including counseling, clinical, surgical, and/or psychiatric consultations and evaluations. HCFs are categorized as hazardous and high-risk work environments since they employ more than 59 million people worldwide and provide a wide range of services to consumers and patients. Similar to other high-risk workplaces, healthcare facilities are characterized by a high degree of hazard agent exposure, which poses a serious risk to the health and life of employees (HCWs). Risk is the likelihood that harm to "life, health, and or the environment" will result from a circumstance, whereas hazards are intrinsic properties of a material, agent, source of energy, or situation that have the potential to cause negative effects. In this context, workplace behaviors that have the potential to result in harm or illness are referred to as occupational risks. Workplace safety generally refers to the practice of protecting staff members' health and safety while on the job, regardless of their line of work. Occupational safety is the control of risks in the workplace to attain an acceptable level of risk [134]. The high rates of related morbidity and mortality among exposed workers make occupational health and safety a crucial problem. About 400,000 new cases of occupational diseases are reported each year, and an estimated 100,000 people pass away from them. Due to their exposure to varied types and levels of workplace dangers, this has an impact on employees in a variety of occupations. The biggest risk of exposure to high-risk occupational hazards is seen in the farming, general contracting, steel, automobile, truck driving, and nursing sectors, according to studies. Oluwagbemi claims that over the past 30 years, HCFs in Nigeria have grown in size, sophistication, and diversity with difficulties maintaining the best practices and tools needed to carry out high-risk clinical treatments. Protecting the health and wellbeing of front-line healthcare professionals (HCWs) is challenging for HCFs, but HCWs may be exposed to risks while doing their statutory obligations that seriously harm their health and quality of life. HCWs may be exposed to risks that have a major negative impact on their health and quality of life, which has a cascading effect on their close relatives. Therefore, HCWs require protection from working dangers just as much as employees of other high-risk industries like mining or construction. HCWs (medical doctors, nurses, and nursing assistants) in Nigeria are ill-equipped to deal with occupational dangers and consequently suffer injuries or illnesses while carrying out their tasks. The lack of adequate facilities with equipment that could improve best practices in underdeveloped nations exacerbates the vulnerability of the workers in HCFs [135.] Therefore, occupational vulnerability of HCWs poses a challenge to the provision of high-quality healthcare in developing nations, particularly for physicians, nurses, and nursing assistants. The few research on occupational hazards among HCWs in underdeveloped nations tended to be more focused on certain job titles within the healthcare delivery system. While this study evaluated the occupational risks and safety procedures among healthcare workers whose job descriptions require them to interact directly with patients practically every day in WHO (2017) categorized the risks in HCFs into physical, biological, mechanical, ergonomic, chemical, and psycho-social risks. Although they could be decreased or eliminated, previous research has revealed that occupational injuries and illnesses among HCWs rated among the highest of any industry. Blood-borne diseases, such as the Human Immunodeficiency Virus (HIV), Hepatitis B virus (HBV), and Hepatitis C virus (HCV), back and neck pain, burnout stress, allergic responses to latex materials, chemical spills, and exposure are the main risks for HCWs. Inadequate staffing, an excessive workload, a lack of protective aids and equipment, negligence and carelessness on the part of healthcare workers, as well as failure to follow basic safety and hygiene guidelines are some of the factors that contribute to occupational illnesses and injuries in HCFs. Because of these, the US Centers for Disease Control and Prevention (CDC) created standard precautions (SPs) to guard against handling infectious materials in HCFs and avoiding occupational exposures to them. It has been demonstrated that following the SP standards can reduce occupational diseases and injuries among HCWs working in HCFs. Physical, financial, and psychological harm to HCWs and their dependents are all effects of occupational illnesses and injuries. HCWs (medical practitioners, However, this study evaluated the occupational risks and safety procedures among healthcare workers—medical doctors, nurses, and nursing assistants—whose job descriptions call for virtually daily direct patient contact in the majority of HCFs (MdNNA). This study determined the causes of occupational hazards and predisposing factors among the chosen HCWs in the Nigerian study area [136].

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Chapter Three

Methodology

3.1 Research Design

The study is a quantitative study; a descriptive cross-sectional design was adopted for this study. This design is suitable for the study because it allows collection of data from a representative sample of laboratories selected from the study population through a simple random sampling technique, using a paper-based questionnaire and the findings was generalized on the entire study population.

Study Location/Area

The study was carried out in Ibadan South West Local Government Area, Oyo State. Across selected public and private Laboratories.

Ibadan South-West LGA

Ibadan South-West is a Local Government Area in Oyo State, Nigeria. Its headquarters are at Oluyole Estate in Ibadan. Its area or districts includes Ring-Road, Oke -Ado, Oke-Bola, Gege. Born Photo, and Isale-Osi. It has an area of 40km^3 and a population of 282,585 at the 2017 census.

Ibadan South West Local Government Area is headquartered in Aleshinloye town of Oyo state, consisting the major districts of Awodife, Bode Oluyole, Osi, Aleshinloye and 11 wards.

Ibadan Southwest Local Government Area is one of the existing LGAs in Oyo state, Nigeria which was created out from the defunct Ibadan Municipal Government during the regime of Gen. Ibrahim Babangida on the 27th day of August 1991.

This local government get their income and revenue majorly from drilling services, commercial activities, certificate issuing, tax/fine, hiring of plants and equipment among others for the development of the entire districts and communities under its jurisdiction.

3.2 Study Population

The study was conducted among Medical Laboratory Practitioners in selected public and private Laboratories across Ibadan South West Local Government Area, Oyo State.

3.3 Sample and Sampling Techniques

Sampling

From the comprehensive list of all registered Medical Laboratories in Oyo State categorized by Local governments where they are domiciled from the ministry of health, simple random sampling technique was employed to select the medical laboratories to be included in the study.

Sample size/Method

The sample size for this study was calculated using **the RAOSOFT Method**

Using RAOSOFT online sample size calculator,

Acceptable margin of error at 5%

Confidence interval of 95%

An estimated population size of 500 medical laboratory practitioners in Ibadan South West Local Government Area, Oyo State, the Study site and 50% response distribution.

The recommended sample size was **218**.

10% attrition value was added to the number to make room for attrition and missing or incomplete data.

Based on this, **22** was added to the total figure of **218** making **240** personnel of Medical Laboratory Practitioners in selected public and private Laboratories across Ibadan South West Local Government Area, Oyo State will be sampled for the study.

3.4 Description of the Research Instrument

A semi-structured, self-administered questionnaire containing questions culled from previous studies that adequately addresses the topic was individually administered to the respondents after their consents have been obtained and assured that all information provided would be treated confidentially and used for research purposes only. Research Assistants were recruited to provide guidance where needed and assist in the administering of the developed questionnaire.

3.5 Validity of Research Instrument

Content adequacy was assumed to indicate whether all aspects of the test/measurement were covered. Language tests have been developed to measure reading, writing, listening and speaking ability. Indicates that the content of the test is highly valid.

3.6 Reliability of the Research Instrument

A retest was introduced to measure the consistency of results at different time points. After repeating the measurements, it was determined whether the results were the same. For example, to check the quality of the tool, we first distributed a questionnaire to a group of medical professionals and then repeated it with many groups. It means that different groups of participants gave the same answers, which means that retesting is more reliable and the questionnaire is more effective.

Inclusion criteria

1. A Medical Laboratory Practitioner currently working in Ibadan South West Local Government are of Oyo State.

2. Graduate of Medical Science Laboratory and any other related course in the laboratory at the tertiary level of education.

3. Participants willing to participate in the study

Exclusion criteria

1. Medical Laboratory Practitioners in non-selected public and private Laboratories across Ibadan South West Local Government Area, Oyo State.

2. Participants not willing to participate in the study.

3. Medical Laboratory Practitioners who did not study a medical science laboratory or related course at a tertiary level.

3.7 Data collection

The data collected was made possible through the use of self-structured questionnaire which was opened and closed ended, self-administered version designed to assess the knowledge of laboratory practitioners on standard laboratory safety and health measures, to assess the adherence of Medical Laboratory Practitioners to Good Safety and Healthy Practices and to determine the correlations between the knowledge, adherence and socio-demographic characteristics of Medical Laboratory Practitioners on Safety and Healthy Practices were administered to the respondents after their consent have been obtained and assured that all information provided would be treated confidentially and use for research purposes only.

3.8 Data analysis

Each filled questionnaire was double-checked for completeness and was coded. Designed data entry screens using Microsoft Excel for Windows was used to translate the paper questionnaires into electronic data for analysis. The respondents' feedback was anonymous and summarized descriptively for each question, using the appropriate statistics (percentages or mean values) using SPSS version 26.0 (SPSS Inc. Chicago, IL) statistical packages. Socio demographic questions were analyzed using descriptive statistics and inferential statistics were employed to determine inter-relationship between variables. The descriptive statistics (frequency, proportion mean and standard deviation) were used to achieve objective one and two. Chi-square test was used to examine the association between Adherence, Knowledge and other Socio-demographic characteristics (objective three). Findings from the survey would be published in a local journal and the outcome will be shared with the concerned agencies and interested respondents.

3.9 Ethical approval

The applicable ethics committee approval was obtained from the State Ministry of health.

Chapter Four

Results and Discussion of Findings

4.1 Demographic Data Analysis

Table 4.1 shows that the mean age of the respondent and standard deviation of the respondent at 36.63(9.407) and mean years of experience of the respondent 11.57 with standard deviation of 8.101.

Table 4.1: Mean characteristics of the respondent

Variable	Mean	Standard deviation
Age	36.63	9.407
Years of experience	11.57	8.101

Table 4.2 shows that out of 321 respondent, 87(37.7%) are males while 144(62.3%) are females. It shows that 44(19%) out of the respondents are single, 154(66.7%) are married, 17(7.4%) are divorced, while 16(6.9%) are widow(er). The result shows that 120(51.9%) are practicing Christianity, 102(44.2) are practicing Islam, while 9(3.9%) are traditionalist.

The result shows that 42(18.2%) of the respondent had secondary education, 83(35.9%) had ND/NCE, 65(28.1%) had HND/BSc., while 41(17.7%) had MSc. and above.

The study shows that 60(26%) out of the respondents are working in the reception, 46(19,9%) are working in phlebotomy, 100(43.3%) are working in the main laboratory while 25(10.8%) are working in the store. The result shows that 54(23.4%) are lab attendants, 35(15.2%) are lab assistants, 57(24.7%) are lab technicians while 85(36.8%) are lab scientist. The study also shows that 8(3.5%) of the respondents are earning less than #18,000, 39(16.9%) are earning #18,000 to #30,000, 50(21.6%) of the respondents are earning #30,000 to #50,000, 66(28.6%) are earning #50,000 to #100,000, while 68(29.4%) are earning above #100,000.

Table 4.2: Background characteristics of the respondent

Variable	Frequency	Percent %
Sex		
Male	87	37.7
Female	144	62.3
Marital status		
Single	44	19
Married	154	66.7
Divorced	17	7.4
Widow(er)	16	6.9
Religion		
Christianity	120	51.9
Islam	102	44.2
Traditional	9	3.9
Level of education		
Secondary	42	18.2
ND/NCE	83	35.9
HND/BSc.	65	28.1
MSc. And above	41	17.7
Working units		
Reception	60	26
Phlebotomy	46	19.9

Main laboratory	100	43.3
Store	25	10.8
Cadre		
Lab attendants	54	23.4
Lab assistants	35	15.2
Lab technician	57	24.7
Lab scientist	85	36.8
Income level		
Less than #18,000	8	3.5
#18,000 - #30,000	39	16.9
#30,000 - #50,000	50	21.6
#50,000 - #100,000	66	28.6
#100,000 and above	68	29.4

4.2 Presentation of Data

4.2.1 What is the level of knowledge of Medical Laboratory Practitioners on Health and Safety Practices in the Laboratory?

Table 4.3 shows that 230(99.6%) answered correctly that safety is important in the laboratory, while 1(0.4%) answered the same question incorrectly.

The result shows that 215(93.1%) answered correctly that they know how to ensure safety in the laboratory while 16(6.9%) answered the same question incorrectly.

The result shows that 224(97%) if the respondents answered correctly that they know how to use PPE such as gloves, laboratory coats etc. in the laboratory, while 7(3%) answered the same question incorrectly.

The results show that 231(100%) answered correctly that hand washing is very important before and after work.

The study shows that 229(99.1%) of the respondent answered correctly that waste items should be properly disposed in a waste container while 2(0.9%) answered the same question incorrectly.

The study shows that 192(83.1%) of the respondent know how to use laboratory safety manual while 39(16.9%) answered the same question incorrectly.

The study shows that 219(94.8%) of the respondent answered correctly that medical laboratory practitioners should be adequately trained in safety and health practices, while 12(5.2%) answered the same question incorrectly.

The result shows that 224(97%) of the respondent shows that storage areas (rooms, refrigerators, freezers, cupboards) where infectious and/or toxic materials are kept labeled accordingly while 7(3%) answered the same question incorrectly.

The study shows that 192(83.1%) of the respondent answered correctly that they should have adequate illumination in the laboratory, while 39(16.9%) answered the same question incorrectly.

The study shows that 231(100%) of the respondents answered correctly they know how to avoid eating and drinking in the laboratory.

The study shows that 229(99.1%) of the respondents answered correctly that all chemicals should be labeled properly, while 2(0.9%) answered the same question incorrectly.

The study also shows that 226(97.8%) of the respondent answered correctly that all chemicals should be labeled properly while 5(2.2%) answered the same question incorrectly.

Table 4.3: Knowledge about Safety and Healthy Practices in the Laboratory

Variable	Correct	Incorrect
Is safety important in the laboratory?	230(99.6)	1(0.4)
Do you know how to ensure safety in the laboratory?	215(93.1)	16(6.9%)
Do you know you have to use PPE such as gloves, laboratory coats etc. in the laboratory	224(97%)	7(3%)
Do you know hand washing is very important before and after work?	231(100%)	0%
Do you know waste items should be properly disposed in a waste container?	229(99.1%)	2(0.9%)
Do you know how to use laboratory safety manual?	192(83.1%)	2(0.9%)
Do you know medical laboratory practitioners should be adequately trained in safety and health practices?	219(94.8%)	12(5.2%)
Do you know that storage areas (rooms, refrigerators, freezers, cupboards) where infectious and/or toxic materials are kept labeled accordingly?	224(97%)	7(3%)
Do you know you should have adequate illumination in the laboratory?	192(83.1%)	39(16.9%)
Do you know you should avoid eating and drinking in the laboratory?	231(100%)	0%
Do you know all chemicals should be labeled properly?	229(99.1%)	2(0.9%)
Do you know all work surfaces in the laboratory be regularly disinfected each day of work?	226(97.8%)	5(2.2%)

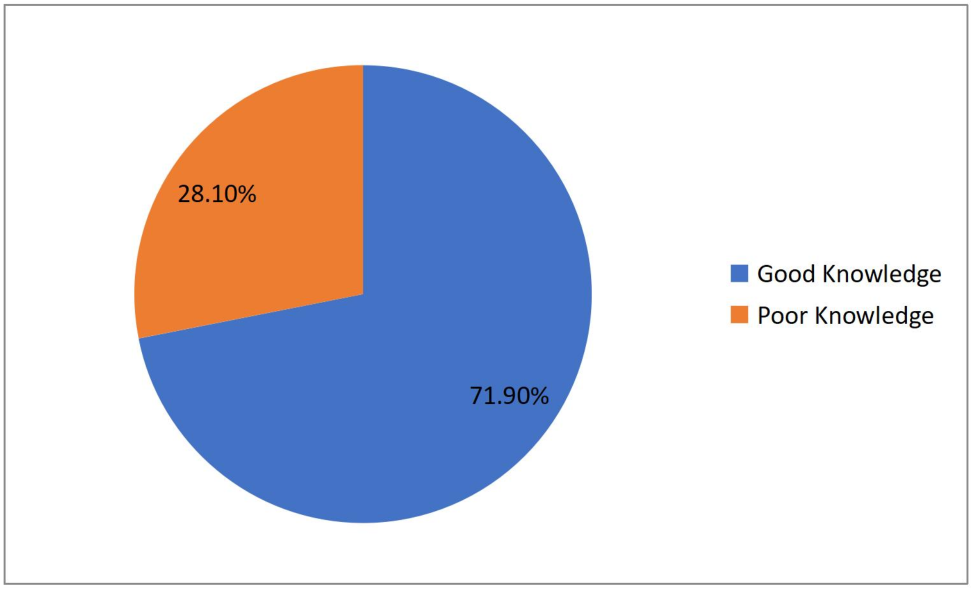

Figure 4.1: Percentage Distribution of Knowledge about Safety and Healthy Practices

Figure 4.1 show that 93.10% of the respondents has good knowledge about safety and health practices.

4.2.2 What are the levels of Adherence of Medical Laboratory Practitioners to Good Safety and Healthy Practices?

Table 4.4 shows that 199(86.1%) of the respondents answered correctly that they always use your PPE such as gloves, laboratory coats etc. in the laboratory, while 32(13.9%) answered the same question incorrectly.

The result shows that 204(88.3%) of the respondent answered correctly that they always refrain from having contact with your eyes, nose, mouth and lips while working in the laboratory while 27(11.7%).

The result shows that 41(17.7%) of the respondent answered correctly that they always use your cell-phone and other personal items (purses, backpack, books, magazines etc.) in the laboratory while 190(82.3%) answered the same question incorrectly.

The result shows that 212(91.8%) of the respondent answered correctly that they always wash your hands before and after every laboratory procedures while 19(8.2%) answered the same question incorrectly.

The result shows that 223(96.5%) of the respondent answered correctly that always dispose laboratory waste in the appropriate waste container while 8(3.5%) answered the same question incorrectly.

The result shows that 181(78.4%) of the respondents answered correctly that they always use laboratory safety manual in your laboratory while 50(21.6%) answered the same question incorrectly.

The result shows that 175(75.8%) of the respondent answered correctly that they always attend the safety training organized on laboratory procedures while 56(24.2%) answered the same question incorrectly.

The result shows that 221(95.7%) of the respondents answered correctly that they always ensure storage areas (rooms, refrigerators, freezers, cupboards) where infectious and/or toxic materials are kept labeled, while 10(4.3%) answered the same question incorrectly.

The result shows that 180(77.9%) of the respondents answered correctly that they always have an adequate illumination in the laboratory while 51(22.1%) answered the same question incorrectly.

The result shows that 223(96.5%) of the respondent answered correctly that they always avoid eating and drinking in the laboratory, while 8(3.5%) answered the same question incorrectly.

The result shows that 224(97%) of the respondents answered correctly that they always label chemicals accordingly, while 7(3%) answered the same question incorrectly.

The result also shows that 190(82.3%) of the respondents answered correctly that they always disinfect all work surfaces in your laboratory after laboratory procedures, while 41(17.7%) answered the same question incorrectly.

Table 4.4: Adherence to Safety and Healthy Practices in the Laboratory

Variable	Correct	Incorrect
Do you always use your PPE such as gloves, laboratory coats etc. in the laboratory?	199(86.1%)	32(13.9%)
Do you always refrain from having contact with your eyes, nose, mouth and lips while working in the laboratory?	204(88.3%)	27(11.7%)
Do you always use your cell-phone and other personal items (purses, backpack, books, magazines etc.) in the laboratory?	41(17.7%)	190(82.3%)
Do you always wash your hands before and after every laboratory procedures?	212(91.8%)	19(8.2%)
Do you always dispose laboratory waste in the appropriate waste container?	223(96.5%)	8(3.5%)
Do you always use laboratory safety manual in your laboratory?	181(78.4%)	50(21.6%)
Do you always attend the safety training organized on laboratory procedures	175(75.8%)	56(24.2%)
Do you always ensure storage areas (rooms, refrigerators, freezers, cupboards) where infectious and/or toxic materials are kept labeled accordingly	221(95.7%)	10(4.3%)
Do you always have an adequate illumination in the laboratory?	180(77.9%)	51(22.1%)
Do you always avoid eating and drinking in the laboratory?	223(96.5%)	8(3.5%)
Do you always label chemicals accordingly?	224(97%)	7(3%)
Do you always disinfect all work surfaces in your laboratory after laboratory procedures?	190(82.3%)	41(17.7%)

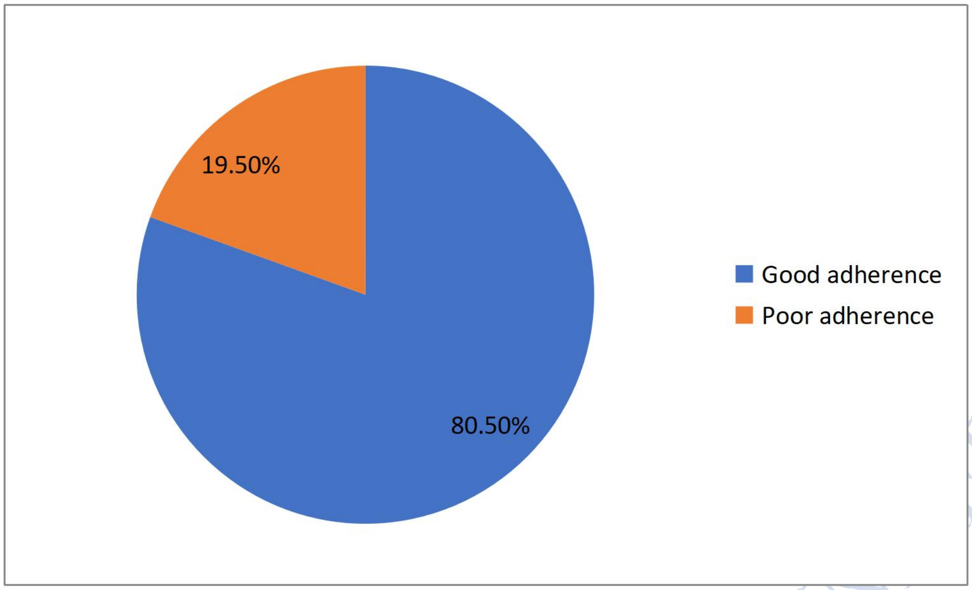

Figure 4.2: Percentage Distribution of Adherence to Safety and Healthy Practices

Figure 4.2 shows that 80.50% of the respondents has good adherence to safety and healthy practices

4.2.3 What are the correlations between the knowledge, adherence and socio-demographic characteristics of Medical Laboratory Practitioners to Good Safety and Healthy Practices?

Table 4.5 shows that there is no significant association between adherence of safety and healthy practices and sex of the respondents.

There is significant association between marital status and adherence to safety and healthy practices at P-value of 0.

There is significant association between religion of the respondent and adherence of safety and healthy practices at P-value of 0.028.

There is significant association between level education of the respondents and adherence to safety and healthy practices at P-value 0.

There is significant association between working units of the respondent and adheence to safety and healthy practices at P-value of 0.

There is significant association between cadre of the respondents and adherence to safety and healthy practices of P-value of 0.

There is no significant association between income level of the respondent and adherence to safety and healthy practices of P-value of 0.086.

There is no significant association between age of the respondents and adherence to safety and healthy practices at P-value of 0.226.

There is significant association between years of experience of the respondents and adherence to safety and healthy practices at P-value of 0.042.

There is significant association between knowledge of safety and healthy practices and adherence of safety and healthy practices at 0.002

Table 4.5: Association between Adherence, Knowledge and other Socio-demographic characteristics

Variables	Good adherence	Poor adherence	Chi-square	P-value
Sex			0.495	0.482
Male	78.2	21.8		
Female	81.9	18.1		
Marital status			12.419	0
Single	67.5	32.5		
Married	87	13		
Religion			4.85	0.028
Christianity	75	25		
Islam	86.5	13.5		
Level of education			20.707	0
NCE/ND	69.6	30.4		
BSc. And above	93.4	6.6		
Working units			19.811	0
Reception	67.9	32.1		
Main laboratory	91.2	8.8		
Cadre			15.849	0
Lab assistant	67.4	32.6		
Lab scientist	88.7	11.3		
Income level			2.951	0.086
#50,000 below	75.3	24.7		

#100,000 and above	84.3	15.7		
Age			2.973	0.226
19 to 29 years	73.2	26.8		
30 to 39 years	84.8	15.2		
40 and above	80.7	19.3		
Years of working experience			6.353	0.042
1 to 7 years experience	71.5	28.4		
8 to 14 years experience	85.9	14.1		
15 years and above	84.7	15.3		
Knowledge			9.488	0.002
Good knowledge	85.5	14.5		
Poor knowledge	87.7	32.3		

Table 4.6, the result shows that respondent who are single are 2 times more likely not to adhere to safety and healthy practices compared to their counterpart who are married at (0.920, 4.403 CI). The result shows that respondent that are practicing Christianity are 1 time more likely not to adhere to safety and healthy practices compared to their counterpart who are practicing Islam at (0.905, 4.163 CI). The result shows that respondent that are NCE/ND holder are 1 time likely not to adhere to safety and healthy practices compare to their counterpart who has BSc., and above at (0.610, 5.382 CI). The result shows that respondent who are working at the reception are 2 times more likely not to adhere to safety and healthy practices compared to their counterparts who are working in the main lab at (1.214, 6.840 CI). The result shows that respondents that are lab assistant are 1 time more likely not to adhere to safety and healthy practices compared to their counterpart who are lab scientist at (0.759, 3.717 CI). The result shows that respondents that has 1 to 7 years experience are 1 time more likely not adhere to safety and healthy practices compared to their counterpart who has worked for 15 years and above at (0.530, 3.311 CI). The result also shows that respondents that has 8 to 14 years experience are 1 time more likely not to adhere to safety and healthy practices compared to their counterpart who has worked 15 years and above at (0.358, 2.804 CI). The result shows that respondent who has good knowledge are 1 time less likely not to adhere to safety and healthy practices compared to counterpart who has poor knowledge at (0.244, 1.174 CI).

Table 4.6: Factors influencing adherence and Socio-demographic characteristics

Variables	UOR	95% CI	P-value	AOR	95% CI	P-value
Sex			.482			
Male	1.268	.654, 2.460				
Female	1					
Marital status			0.001			0.080
Single	3.221	1.649, 6.292		2.012	0.920, 4.403	
Married	1					
Religion			0.030			0.088
Christianity	2.133	1.077, 4.224		1.942	0.905, 4.163	
Islam	1					
Level of education			0.000			0.284
NCE/ND	6.177	2.624, 14.541		1.813	0.610, 5.382	
BSc. And above	1					
Working units			0.000			0.016
Reception	4.894	2.332, 10.669		2.881	1.214, 6.840	
Main laboratory	1					
Cadre			0.000			0.201

Lab assistant	3.806	1.922, 7.539		1.679	0.759, 3.717	
Lab scientist	1					
Income level			0.088			
#50,000 below	1.769	0.919, 3.407				
#100,000 and above	1					
Age			0.299			
19 to 29 years	1.532	.605, 3.425	0.478			
30 to 39 years	0.752	.342, 1.653				
40 and above	1					
Years of working experience			0.055			0.548
1 to 7 years experience	2.199	.985, 4.911	0.839	1.324	0.530, 3.311	0.997
8 to 14 years experience	0.910	0.368, 2.250		1.002	0.358, 2.804	
15 years and above	1					
Knowledge						0.119
Good knowledge	0.354	0.180, 0.696	0.003	0.536	0.244, 1.174	
Poor knowledge	1					

4.3 Discussion of Findings

4.3.1 Socio-demographic information

Respondent of all ages (19 through to over 40) were represented, with larger numbers in the lowest age bracket 19-24 and 35-39 categories accounting for The number of females interviewed were more 144 (62.3%) compared to males 87(37.7%) , 120(51.1%) were Christians while 102(44.2%) were Muslims, 154(66.7%) reported to be married while 44(19%) said they are single, majority of the respondents with 83(35.9%) reported to have ND/NCE, level of education while 65(28.1%) have HND/BSC with the least 41(17.7%) claimed to have MSc and above as level of education. 100(43.3%) majority reported to work in the main laboratory, 60(26%) work in the reception, with the least percentage of the population 25(10.8%) claimed to work in the store.

Findings from this study revealed that majority 85(36.8%) are laboratory scientist, 54(23.4%) claimed to be lab scientist, 35(15.2%) are lab attendant. Findings also revealed the economic status of the various cadres of the laboratory personnel with majority 68(29.4.2%) claimed to earn above 100,000 while (28.6%) claimed to earn within the range of 30,000 to 50,000. The least earned, with 8(3.5%) earn 18,000. From the above findings, it could be inferred that majority of the respondent were laboratory scientist who practice in the laboratory unit of the hospital, with an earning range above 100,000 as income who are married and happened to be more of the female gender than male.

4.3.2 Knowledge about Safety and Healthy Practices in the Laboratory

The findings of this study shows that 230(99.6%) of the respondents understood the concept of safety in the laboratory while 1(0.4%) claimed safety isn't important in the laboratory. It was also revealed that majority of the respondent claimed to understand how to ensure safety in the laboratory. It was revealed that majority 224(97%) said it's important to ensure the use of PPE such as gloves laboratory coats etc. while working in the Lab. All respondent with aggregate of 100% claimed hand washing is an important act in ensuring safety before and after working.

It was revealed that 229(99.1%) knew that it is important that waste generated should properly be discarded, while 192(83.1%) also claimed they know how laboratory safety manual is used. The findings of this study also revealed that 219(94.8%) claimed that laboratory practitioners should be trained in safety and health practice to ensure proper work ethics according to ISO standard. They also claimed that storage areas as (rooms, refrigerators, freezers etc. should be labelled with for easy identification. It was also revealed that illumination is important in ensuring safety in the laboratory with response rate of 192(83.1%). The whole respondent also claimed that it's wrong to eat or drink in the laboratory. Findings showed that majority 229(99.2%) said it is important to label all chemicals properly in the laboratory. Finally, 226(97.8%) claimed that it's very important to disinfect all work surfaces each day of work. The findings of this study revealed that (71.90%) have good knowledge about safety and healthy practices in the laboratory. The above findings support the International standard Organization, 2003 standard operating procedure in ensuring proper work ethics while working in the laboratory. All questions answered on knowledge of the respondents about work operations in the lab also conforms to a study embarked on by the Center for Disease Control 2020. The standard precautions emphasize the key elements of universal precautions (designed to reduce the risk of pathogens from moist body substances) and apply them to all patients receiving care in hospitals regardless of their diagnosis or presumed infection status, as was discovered by the researcher on safety precautions in the laboratory during the process of reviewing literature.

Hand washing before and after each instance of patient contact, the use of personal protective equipment, the safe use and disposal of sharps, routine environmental cleaning, the processing of reusable medical equipment and instruments, respiratory hygiene and cough etiquette, aseptic non-touch technique, waste management, and the proper handling of linen are all examples of standard precautions. (CDC, 2020) The aforementioned claim supports the claim that the respondent is well-versed in safety procedures. The outcomes of this study on respondent knowledge of safety and healthy practices support the aforementioned claim that the respondent has good awareness of safety precautions and healthy activities.

4.3.3 Medical Laboratory Practitioners practice in line with Safety and Healthy Practice guidelines

Based on this study, findings showed that 80.50% of the respondents has good adherence to safety and healthy practices. The following under discussed findings shows the attitude of Medical Laboratory staff in line with safety and healthy practice.

- Item (I): Do you always use your PPE such as gloves, laboratory coats etc. in the laboratory. Findings showed that majority with 199(86.1%) claimed that they always use PPE such as gloves, laboratory coats etc. while few 32(13.9%) claimed not to use, this shows that the Lab staff understand the use of PPE as an important tool ensuring their safety. The minority who don't use might people who aren't involved with hazardous part of the work.

- Item (II): Do you usually avoid touching your mouth, lips, nose, or eyes while working in a lab? The majority of respondents, 204 (88.3%), stated that they never touched their eyes, nose, or other body parts while working in the lab. These results are in line with research done in 2017 by Kozajda et al., who found that "The most common routes of infections are inhalation (particularly by aerosols), percutaneous inoculation (needle stick injuries, broken glass injury, and/or animal bites or scratches), direct contact between contaminated surfaces (gloves, hands), and mucous membranes, as well as through ingestion - for example, by smoking, eating, or accidental aspiration through aItem (III): Do you always use your cell-phone and other personal items (purses, backpack, books, magazines etc.) in the laboratory? Findings according to this showed that 41(17.7%) which doesn't measure up to half of the respondent claimed to abide to the rule of non-usage of cell-phones and other personal items while working, while majority 190(82.3%) claim they always use their cell-phones or personal items while working. This shows that the laboratory staff doesn't have good work ethics in respect to use of phones and other personal belongings. These findings conform to the purpose of the study to assess the compliance level of Lab staff to the use of PPEs and Lab regulations generally. This will be addressed in the recommendation for the study area and shown as cogent point for future research based on the outcome of this research.

- Item (III): Do you regularly use your phone and other personal belongings, such as handbags, backpacks, books, and magazines, in the lab? The results of this study showed that despite the majority of respondents, 190 (82.3%), claim they always use their personal devices or cell phones while working, just 41 (17.7%), or less than half of the respondents, claimed to adhere to this rule. This demonstrates the lack of acceptable work ethics displayed by the laboratory workers with regard to the use of phones and other personal items. These results are consistent with the study's goal of evaluating the lab staff's level of adherence to PPE usage guidelines and lab regulations in general. Based on the findings of this research, this will be addressed in the recommendation for the study area and demonstrated as a strong topic for future research.
- Item (IV): Do you always wash your hands before and after every laboratory procedures? Findings according to this study showed that majority 212(91.8%) always wash their hands before and after every laboratory procedures, while 19(8.2%) claimed not to wash their hands before or after any procedure. This finding will be suggested as a recommendation to all Lab staff for proper personal hygiene at work place.
- Item (VI): Do you always dispose laboratory waste in the appropriate waste container? Findings revealed that majority 223(96.5%) claimed they always dispose waste in the appropriate waste container while minority 8(3.5%) claimed that they don't usually dispose accordingly. According to a study conducted by Google scholar "Standard precautions include hand washing; use of barriers (gloves, gown, cap and mask); care with devices, equipment and clothing used during care; environmental control (surface processing protocols and health service waste handling); adequate discarding of sharp instruments; and patient's accommodation in

accordance to requirement levels as an infection transmission source" This findings revealed that when standard precaution are taken, infections are limited.

- Item (VII): Do you always use laboratory safety manual in your laboratory?

  Findings revealed that majority 181(78.4%) claimed they always use their laboratory safety manual while in the Lab while 50(21.6%) claimed they don't use the laboratory manual.

- Item (VIII): Attend the safety training sessions on lab operations as often as possible. 175 people, or 75.8%, said they regularly participate in safety training sessions on lab techniques. While 24.2% of respondents said they rarely go to training sessions on laboratory techniques. These results support a statement made in the review of the literature that some studies have indicated that there is selective adherence and non-adherence to general and recommended precautions in routine medical practice, and that these discrepancies in knowledge and adherence by medical professionals may be influenced by the various types of training they have received (Abdulraheem, *et al* 2017) Trainings are crucial to assist people unlearn some harmful notions or concepts that are out of step with current practice.

- Item (IX): Do you consistently make sure that spaces where infectious or dangerous products are stored are labeled appropriately (rooms, refrigerators, freezers, cupboards)? A majority of 221 respondents (95.7%) said that harmful material storage places are always labeled. 10 (4.3%) claimed they had not labeled the locations of these things. The fact that they are housed in a secure location that only authorized personnel may access may be the cause of this.

  On this basis of all statistical information revealed above, it's evident that majority of respondents who took part in this study, confirms that Medical Laboratory Practitioners practices are in line with Safety and Healthy Practice guidelines- these assertions were made on the basis that almost all questions asked on practice of Medical Laboratory practitioners revealed that majority of the respondent got the questions right according to ISO standard.

4.3.4 Association between knowledge and the Adherence of Medical Laboratory Practitioners to Good Safety and Healthy Practice

- Item (I): Findings from the result revealed that, there is no significant association between adherence of safety and healthy practices and sex of the respondents. It was revealed that a p-value of 0.482, this shows that the result is not significant, with the value more than 0.05, hence the null hypothesis was accepted.

- Item (II): findings from analysis shows that there is significant association between marital status and adherence to safety and healthy practices at P-value of 0. This could mean that, since majority of the respondent are married, there is an awareness on the effect of hazard they will face if they do not have good adherence to the Lab guidelines or safety practices which can also be a threat to their family after work.

- Item (III): findings from analysis shows that there is significant association religion of the respondent and adherence of safety and healthy practices at P-value of 0.028. This could be inferred that with the introduction of regular hand washing at religious gathering, thus have a positive effect at work place still practicing that, since majority of the respondent are married, there is an awareness on the effect of hazard they will face if they do not have good adherence to the Lab guidelines or safety practices which can also be a threat to their family after work.

- Item (IV): The results of the research demonstrate a significant, P-value 0 relationship between respondents' educational level and adherence to safe and healthy activities. Given that the majority of respondents are married, it can be assumed that the introduction of routine hand washing at religious gatherings will have a positive impact on workplace hand washing practices. Respondents are aware of the dangers they may face if they do not adhere to the Lab's safety procedures, which may also pose a threat to their families after work. There is significant association between working units of the respondent and adherence to safety and healthy practices at P-value of 0.

With a P-value of 0, there is a strong correlation between the respondents' demographics and their adherence to safe and healthy behaviors.

With a P-value of 0.086, there is no correlation between the respondent's income level and their commitment to safe and healthy habits.

At a P-value of 0.226, there is no correlation between respondents' ages and adherence to healthy and safe habits.

At a P-value of 0.042, there is a significant correlation between respondents' years of experience and adherence to safe and healthy behaviors.

At 0.002, there is a significant correlation between understanding safety and health practices and following them.

4.3.4.1 Factors influencing adherence and Socio-demographic characteristics

Table 4.6, the result shows that respondent who are single are 2 times more likely not to adhere to safety and healthy practices compared to their counterpart who are married at (0.920, 4.403 CI). The result shows that respondent that are practicing Christianity are 1 time more likely not to adhere to safety and healthy practices compared to their counterpart who are practicing Islam at (0.905, 4.163 CI). The result shows that respondent that are NCE/ND holder are 1 time likely not to adhere to safety and healthy practices compare to their counterpart who has BSc., and above at (0.610, 5.382 CI). The result shows that respondent who are working at the reception are 2 times more likely not to adhere to safety and healthy practices compared to their counterparts who are working in the main lab at (1.214, 6.840 CI). The result shows that respondents that are lab assistant are 1 time more likely not to adhere to safety and healthy practices compared to their counterpart who are lab scientist at (0.759, 3.717 CI). The result shows that respondents that has 1 to 7 years' experience are 1 time more likely not adhere to safety and healthy practices compared to their counterpart who has worked for 15 years and above at (0.530, 3.311 CI). The result also shows that respondents that has 8 to 14 years' experience are 1 time more likely not to adhere to safety and healthy practices compared to their counterpart who has worked 15 years and above at (0.358, 2.804 CI). The result shows that respondent who has good knowledge are 1 time less likely not to adhere to safety and healthy practices compared to counterpart who has poor knowledge at (0.244, 1.174 CI).

Chapter Five

Conclusion

5.1 Summary of Findings

This chapter presents the discussion, conclusion and recommendation. The chapter was discussed using the following outline:

Discussion

The study looked at the methods used by medical laboratory professionals in Ibadan, Oyo State, with regard to safety and health. 500 Medical Laboratory workers who worked in both commercial and public hospital laboratories throughout Ibadan South West Local Government Area, Oyo State, were the study's target group. 240 people were chosen as the sample size. For the study, a simple random selection method was utilized to choose participants. This was created using the online sample size calculator by RAOSOFT.

In the study we found out that the Respondents mean age is 35 years. It was also revealed that number of females interviewed were more than males with 144 (62.3%) as the majority. The findings are related to Tooba *et al*., 2020 with 57.6% female and 42.4% for male, and that of WHO publication in 2018 with 52% and 48% for female and male respectively. Majority 120(51.1%) were Christians while 102(44.2%) were Muslims, 154(66.7%) reported to be married while 44(19%) said they are single, majority of the respondents with 83(35.9%) reported to have ND/NCE, level of education while 65(28.1%) have HND/BSC with the least 41(17.7%) claimed to have MSc and above as level of education. 100(43.3%) majority reported to work in the main laboratory, 60(26%) work in the reception, with the least percentage of the population 25(10.8%) claimed to work in the store.

The mean age of respondents was 36.63, it is in agreement with the publication of WHO in 2018 with mean age of 36.82.

The study's findings showed that (93.10%) people are well-informed about safe and healthy laboratory procedures. The aforementioned results satisfy the International standard Organization's 2003 standard operating procedure by guaranteeing adequate work ethics when conducting laboratory work, and also shows higher percentage like that of Tooba *et al.,* 2020 with 83.2%. All responses to the questions about respondents' understanding of lab work procedures are consistent with research conducted by the Center for Disease Control 2020. The standard precautions emphasize the key elements of universal precautions (designed to reduce the risk of pathogens from moist body substances) and apply them to all patients receiving care in hospitals regardless of their diagnosis, as was discovered during the researcher's review of the literature on safety precautions in the laboratory.

It was concluded based on the findings revealed after analysis and interpretation of the data collection using the survey tool. It could be deduced that the respondent has good knowledge of safety precautions and healthy practices with the findings of this study as revealed.

It was also revealed from the findings of the study that Medical Laboratory Practitioners practice is in line with Safety and Healthy Practice guidelines, it was revealed that (80.50%) of the respondents has good adherence to safety and healthy practices. It was discovered that safety and healthy practice such as PPEs usage has high adherence, while few who don't use are people who are not exposed to such hazard that requires the usage, probably as a result of where they work i.e., Receptionist, who only document.

It was also revealed that 88% claimed they always refrain from any form of contact to openings in their body, this findings support a study by (Kozajda *et al.,* 2017) which revealed that "The most common routes of infections are inhalation (particularly by aerosols), percutaneous inoculation (needle stick injuries, broken glass injury, and/or animal bites or scratches), direct contact between contaminated surfaces (gloves, hands) with this level of correct response rate, it shows their adherence level is commendable.

It was discovered that on the part of usage of mobile phones and personal belongings in the Lab, the adherence level to this rule is low and not encouraging. This according to a study carried out by (Auriga, 2020) claimed that working in the lab does not require undivided attention and that's why phones and personal belongings must be kept away. It's also important for a provision for a safety box to ensure adequate safety of property kept to avoid being stolen by theft.

Findings also showed that majority 212(91.8%) always wash their hands before and after every laboratory procedure, while 19(8.2%) claimed not to wash their hands before or after any procedure. These findings also conform to the directive of CDC that frequent washing of hand should be accepted, this limits the chances of contaminating and transferring diseases.

Findings revealed that majority 223(96.5%) always dispose laboratory waste in the appropriate waste container, minority 8(3.5%) claimed that they don't usually dispose accordingly. This could be as a result of non-provision of proper waste bin with appropriate color code that allows waste to be properly discarded according to their categories according to (WHO, 2017).

Other findings such as; training of Laboratory Practitioners was also discovered to ensure appropriate and safety precautions with majority 175(75.8%) claimed to have attended one training or the other concerning health and safety which correlate with their knowledge concerning safety and healthy safety guidelines in the laboratory. Additionally, it was found that storage spaces (rooms, refrigerators, freezers, and cupboards) where hazardous or infectious products are maintained are labeled appropriately. The fact that 221 respondents (95.7%) said that storage places where harmful materials are maintained are always labeled indicates that the majority of the population of interest understood the significance of labeling such containers or storage to prevent inappropriate or incorrect use of the chemicals.

5.2 Conclusion

The study examined the Safety and Healthy practices among the Medical laboratory practitioners in Ibadan Oyo State. It was evident that the participants (Laboratory Professionals) have good knowledge of health and safety practices either as a private worker or government worker at any laboratory Centre or hospital clinic.

These findings are consistent with the findings of (Tooba *et al.,* 2022), which back up the study on how knowledge is a key determinant in deciding how much adherence level the laboratory put into practice. Patients are less likely to receive the best care possible without dependable medical laboratory support, and outbreaks and the spread of serious infectious diseases cannot be effectively stopped. This is why the government requires to take interest in the need of this profession to allow them gibe their best of productivity. It's imperative that this study should be conducted at regular interval and at a wider population such as tertiary care centers, or the state itself should ensure the training on safety precautions so that all department that have closeness with the lab will understand how to relate when at such gathering

On the basis of all statistical information discovered through analysis been done, the above, is evident that majority of respondents who took part in this study, confirms that Medical Laboratory Practitioners practices are in line with Safety and Healthy Practice guidelines in at their respective various work station.

5.3 Recommendation

The results of this study suggested that;

1) The respondents were against avoidance of their smartphones at work which will only give them divided attention which can lead to incorrect sample result or mixing up of the samples. It's is important to organize trainings or create real live experiences that will make them change the habit using smartphones at work. This supports the claim of (CDC) on safety precaution needed for standard operation at either private or public Laboratory.
2) The findings of the study showed that the respondent have good relationship with knowledge on safety precautions and how best to operate in the Lab.
3) The National Association of Medical Laboratory Practitioners should provide an updated knowledge on safety precautions and how best to operate in the Laboratory.

5.4 Contribution to Knowledge

The study was able to identify knowledge and adherence gap to safety and healthy practices among Medical laboratory practitioners in Ibadan South West Local Government, Ibadan, Oyo State. It also suggested an updated knowledge on safety precautions and how best to operate in the Laboratory to the Practitioners.

5.5 Suggested Areas for Future Researches

1) To determine the adherence of Medical Laboratory Practitioners to Safety and Healthy Practices.
2) To determine the knowledge of Safety precautions taken among Medical Laboratory Practitioners.
3) To determine the adherence of Medical Laboratory Practitioners to Safety Precautions in the Laboratory.

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Appendix I

Consent Form

Consent for Participation in Study

Description: I am Shittu Ahmed Adeniyi, a final year post graduate student on MPH programme of the above-named institution, conducting a study on Safety And Healthy Practices Among The Medical Laboratory Practitioners In Ibadan South West Local Government, Oyo State. This is an independent evaluation and your feedback will help in determining the Adherence to Safety and Healthy practices among selected Medical laboratory practitioners in Ibadan South West Local Government, Oyo state.

Time Involvement: Your participation will take approximately 30 minutes.

Risks And Benefits: There is a minimal risk that can be associated with your participation in this study in case any information you provide can be directly linked to you. Study ID codes will be used to protect your identity from study directors, your employers, and the general public. There will be no dissemination of any identifying information alluding to who provided which responses and results will be presented without any identifying factors.

The benefits which may reasonably be expected to result from this study is designed to know how you assess the laboratory practices done in your various Laboratories, to assess the potential hazards various Medical Laboratory Practitioners may be facing and to provide information on good safety and healthy practices to be done by various Medical Laboratory Practitioners.

We cannot and do not guarantee or promise that you will receive any benefits from this study**.** Your decision whether or not to participate in this study will not affect your employment or role in data collection for the current study.

Payments: You will not receive any payment for your participation.

Participant's Rights: If you have read this form and have decided to participate in this project, please understand your participation is voluntary and you have the right to withdraw your consent or discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled. The alternative is not to participate. You have the right to refuse to answer particular questions. The results of this research study may be presented at scientific or professional meetings or published in scientific journals. Your identity or any identifiable data will not be included in these results.

Contact Information:

Whom to Contact

Questions: In case you have any question about the study you can ask it. You can also raise your questions, concerns or complaints about this research, its procedures, risks and benefits, on that ground, you are free to contact the principal investigator with any information needed.

Ahmed Adeniyi SHITTU

Department of Public Health

Lead City University Ibadan, Oyo State

shittuahmed01@gmail.com

I give consent to participate in this study.

Yes ☐ No ☐

Name of Participants: ________________________________

Signature or Thumb Print: ___________________

Date: ____

Name of Interviewer: _______________________________

Signature/Date: ____________________________________

Name of Witness (If Applicable): ____________________________

Signature/Thumb print and Date

Appendix III

Questionnaire (Study Tool)

Safety And Healthy Practices Among The Medical Laboratory Practitioners In Ibadan South West Local Government, Oyo State.

SECTION A: Socio-demographic Characteristics (Please tick (√) as appropriate)

1. Name of Facility ……………………………………………………………………

2. Age (as at last birthday): _____________ years

3. Sex: (1) Male (2) Female

4. Marital Status: (1)Single (2)Married (3)Divorced (4)Widow(er)

5. Religion: (1) Christianity (2) Islam (3) Traditional

6. Level of Education: (1) Secondary School and below (2) ND/NCE (3) HND/BSc. (4) MSc. and above

7. Working Units: (1) Reception (2) Phlebotomy (3) Main Laboratory (4) Store

8. Cadre: (1) Lab Attendants (2) Lab Assistants (3) Lab Technician (4) Lab Scientist

9. Income Level: (1) Less than #18,000 (2) #18,000 – #30,000 (3) #30,000 – #50,000 (4) #50,000 – #100,000 (5) #100,000 and above

10. Years of Working Experience: _____________

Section B: Clinical Characteristics

Knowledge about Safety and Healthy Practices in the Laboratory (Q1-Q12)

(Please tick (√) as ppropriate)

YES (1) NO (2) I don't Know (3)

S/N		YES	NO	I DON'T KNOW
1.	Is Safety important in the Laboratory?			
2.	Do you know how to ensure safety in the Laboratory?			
3.	Do you know you have to use your Personal Protective Equipment such as gloves, laboratory coats etc. in the laboratory?			
4.	Do you know Hand washing is very important before and after work?			
5.	Do you know that waste items should be properly disposed in a waste container?			
6.	Do you know how to use laboratory safety manual?			
7.	Do you know that Medical Laboratory practitioners should be adequately trained in Safety and Healthy Practices?			
8.	Do you know that storage areas (rooms, refrigerators, freezers, cupboards) where infectious and/or toxic materials are kept labelled accordingly?			
9.	Do you know you should have an adequate illumination in the laboratory?			
10.	Do you know you should avoid eating and drinking in the Laboratory?			
11.	Do you know you that All chemicals should be clearly			

	labelled?			
12.	Do you know that all work surfaces in the laboratory be regularly disinfected each day of work?			

SECTION C: Clinical Characteristics

Adherence to Safety and Healthy Practices in the Laboratory (Q1-Q34) (Please tick (√) as appropriate)

YES (1) NO (2) I don't Know (3)

S/N		YES	NO	I DON'T KNOW
1.	Do you always use your Personal Protective Equipment such as gloves, laboratory coats etc. in the laboratory?			
2.	Do you always refrain from having contact with your eyes, nose, mouth and lips while working in the Laboratory?			
3.	Do you always use your cellphone and other personal items (purses, backpacks, books, magazines etc.) in the laboratory?			
4.	Do you always wash your hands before and after every Laboratory procedures?			
5.	Do you always dispose laboratory waste in the appropriate waste container?			

6.	Do you always use Laboratory Safety manual in your Laboratory?			
7.	Do you always attend the Safety Training organized on Laboratory Procedures?			
8.	Do you always ensure storage areas (rooms, refrigerators, freezers, cupboards) where infectious and/or toxic materials are kept labelled accordingly?			
9.	Do you always have an adequate illumination in the laboratory?			
10.	Do you always avoid eating and drinking in the Laboratory?			
11.	Do you always label all chemicals accordingly?			
12.	Do you always disinfect all work surfaces in your laboratory after Laboratory procedures?			

Appendix III

Bio-Data

Full Name:	Ahmed Adeniyi SHITTU
Address:	No.71 Zone A, Oluwatedo-Ifesowapo, Amuloko, Off Akanran road, Ibadan, Oyo State.
E-mail Address:	shittuahmed01@gmail.com
Phone No:	08058556434
Date of Birth:	19th February, 1976
Place Birth:	Ibadan
Nationality:	Nigerian
Next of Kin:	Shittu Fatima Omobolanle
Address:	No.71 Zone A, Oluwatedo-Ifesowapo, Amuloko, Off Akanran road, Ibadan, Oyo State.

Education Background:

Islamic Mission School II Idere	1982-1987
Ayelogun Grammar School Idere	1988-1990
Okedere High School Idere	1991-1993
School Of Medical Laboratory Science	1996-2001

MPH in Epidemiology (Lead City University Ibadan) 2020-2020

Work Experience:

General Hospital Tede (Oyo State) 2002-2008

State Hospital Saki (Oyo State) 2009-2013

Adeoyo Maternity Teaching Hospital Ibadan 2014-2019

Ring Road State Hospital Ibadan 2019-2020

Oni Memorial Children Hospital Ibadan 2020 till date

Appendix IV

University Compliance Certificate

This is to certify that the thesis by **Shittu Ahmed Adeniyi** with the Matric Number **LCU/PG/001835** in the Department of PUBLIC HEALTH, Faculty of Basic Medical and Applied Sciences, Lead City University Ibadan, is in full compliance with the approved University format and style.

………………………… ……………..………

Name Date