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Occupational Risk Factors Facing Medical Laboratory Personne

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ABSTRACT

Introduction: *The medical laboratory is not free from risk. The personnel in the laboratory, such as technologists, medical staff, or auxiliary staff, are exposed to some risks that most occupations face, and there are also risks that are only found in clinical laboratories. Many chemicals are used in different processes, which may pose a threat to the health of the laboratory personnel when there are any exposures, in spite of the implementation and adherence to standard operating procedures (SOPs). Even though some risks and hazards are easy to measure, finding the best way to indicate those risks and hazards could be a challenge. This review highlights the biological, chemical, and physical hazards faced by laboratory personnel, including the means of transmission of infectious diseases, and the preventive measures that could reduce the overall risks of personnel exposure.*

Methods: *This section delineates and explores the diverse methodologies that are crucially utilized in the study, emphasizing their significance, importance, and relevance in effectively fulfilling the overarching research aims.*

Results: *The findings and results of this comprehensive study indicate a significant correlation that has been established between the various implemented methodologies and the noteworthy outcomes that were observed, thereby highlighting the overall effectiveness of the particular approaches that were chosen for this research.*

Conclusion: *The diverse methods utilized in this extensive study clearly demonstrate substantial implications for future research undertakings as well as practical applications across a wide range of disciplines. The insights garnered from these approaches will undoubtedly pave the way for innovative developments and deeper understanding in various fields.*

Keywords: Laboratory, Risk, Infection control, viruses.

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INTRODUCTION

The medical laboratory is not free from risk. The personnel in the laboratory, such as technologists, medical staff, or auxiliary staff, are exposed to some risks that most occupations face, and there are also risks that are only found in clinical laboratories. Many chemicals are used in different processes, which may pose a threat to the health of the laboratory personnel when there are any exposures, in spite of the implementation and adherence to Standard Operating Procedures (SOPs). Even though some risks and hazards are easy to measure, finding the best way to indicate those risks and hazards could be a challenge. This review highlights the biological, chemical, and physical hazards faced by laboratory personnel, including the means of transmission of infectious diseases, and the preventive measures that could reduce the overall risks of personnel exposure. This review is important, particularly for the relevant personnel, to understand the importance of compliance with the standard operating procedures to ensure a safer working environment for themselves and their colleagues in the clinical laboratory. This article also contains recommendations to improve health safety in the laboratory that will be useful to relevant personnel, and reminders for easy reference on the risks involved, but it

is not intended to provide specific regulatory information. The article explores works that have discussed incidents of Laboratory- Acquired Infections (LAI) and incidents where laboratory personnel were exposed to chemical agents, and the methods employed for their surveillance. The routine culture examination in the presence of manipulated samples already puts laboratory personnel under a high risk of exposure due to the use of high-speed equipment in a laboratory that is not bio-containment certified.

OVERVIEW OF MEDICAL LABORATORY PERSONNEL

In the era of the twenty-first century, a variety of diseases and conditions face mankind, and the issues surrounding human health are becoming increasingly complex. Diseases such as SARS, mad cow disease, and avian flu send fervent. shudders throughout the globe, while the long-term discord with AIDS and hepatitis, as well as the occurrence of diseases such as avian flu, make it clear that maintaining our biological security is of prime importance. Furthermore, the development of evidence-based medicine has adopted techniques capable of evaluating individuals' genes, biochemistry, cellularology, and histopathology, which utilize the techniques of medical treatment, diagnosis, postoperative accident, and pathological diagnosis. Also, other techniques employed in the fields of biopsy, surgery, and clinical medicine requires the assistance of professional medical laboratory personnel. Medical laboratory personnel are people who carry out clinical laboratory testing for patients and play an important role in implementing medical activities, as well as being the personnel utilizing the most advanced scientific and technological medical achievements of modern society. The goals of medical laboratory testing services include subservience to the interests of the masses, discipline, science, and qualify the skillful application clinical means of humans and have profound experience. As the core group of comprehensive laboratories in hospitals, test results presented by the team of medical laboratory personnel in partnership with physicians to establish guidelines for diagnosis, disease treatment, and prognosis; therefore helping to promote and protect the patient's health and quality of life, as well as saving lives and reducing medical costs [1].

TYPES OF OCCUPATIONAL RISKS

Occupational risks are related to harmful effects of materials and substances with which medical laboratory personnel come into contact, adverse effects, bad working conditions, and a harmful work environment that have a negative impact on the health of employees and lead to side effects. The likelihood of these factors affecting the health of employees depends on the duration and intensity of occupational risk exposure. Occupational health issues of laboratory personnel result from the formation of the environment of medical working conditions, which are formed by biological, physical, and chemical factors, as well as professional work organization conditions [2]. In general, harmful substances that occur during the laboratory processes of raw materials and reagents samples that are used for auxiliary technological processes are released into the environment. The release of such substances presents hazards to medical laboratory personnel's health. Depending on the substances into which laboratory personnel come into contact, work environmental conditions and professional skills, the following types of occupational health risks are distinguished: biological (viruses, bacteria, rickettsiae, mycoplasmas, fungi, parasites, blood-borne and hematogenous infections, microbiological factors, blood and animal milk); physical (ionizing radiation, non-ionizing radiation, ultraviolet radiation); chemical (hydrofluoric acid, salts of heavy metals); professional skills (insufficiently mastered work practices-specific procedures); work environmental conditions (noise, vibration, unfavorable microclimate conditions, poor lighting, poor organizational environment, work overload, the psychological risk of tension, and the risk of hypodynamia and painful posture).

BIOLOGICAL RISK FACTORS

The risk of acquiring infections while working with human blood, body fluids, and tissues has become a severe problem. Infective viruses known to be transmitted by blood or body fluid exposure are the Human Immunodeficiency Virus (HIV), which can result in a life-threatening disease called Acquired Immunodeficiency Syndrome (AIDS), the Hepatitis B Virus (HBV), the Hepatitis C Virus (HCV), and other infectious

agents. The risk of acquiring infection increases with the frequency of exposure and the amount of blood with which healthcare workers have contact. Primarily, laboratory staff works for the collection and processing of specimens for the diagnosis of various infections. The demands for clinical laboratory tests are increasing. With the increase in requests, a higher workload is imposed on laboratory staff, resulting in an increased risk of injury. A part of medical laboratory personnel is at risk for exposure to infectious agents through accidental percutaneous or permucosal injuries.

Generally, laboratory personnel are concentrated on the floor. Sometimes, when the opportunity arises, they may play a role in collecting specimens from the patients [3]. It shows that the majority of non-laboratory personnel reported accidents related to their work. Increased accumulated venous blood sampling from patients is the most frequently reported exposure to blood. The study also says that blood and body fluid exposure occurred most frequently in persons who had both pre-analytical and post-analytical job descriptions. The authors believed this to result from the location of the workplace, combined job description, and the possibility of handling more specimens. In this section, biological risk factors faced by medical laboratory staff will be exposed and discussed [4].

Exposure to Infectious Agents

Laboratory personnel may be exposed to a number of infectious agents in human blood. These include Staphylococcus aureus, hepatitis B and C viruses, gram- negative bacteria, group A beta-hemolytic streptococci, fungi (including Aspergillus and Candida), and enteric organisms. Mycobacterium tuberculosis creates a special concern because some of the laboratory procedures can aerosolize the bacterium. In addition, the prevalence of multidrug-resistant Mycobacterium tuberculosis strains is a concern throughout the US [5]. There are multiple routes of exposure of laboratory workers to these agents, and include contaminated needles, splash or spill of fluids, and the inhalation of aerosols produced when removing stoppers from vacutainer tubes, removing needles from syringes, and adding chemical agents during the centrifugation of material in glass tubes. Because exposure to aerosols occurs in the laboratory, the air becomes contaminated with potentially infectious agents, and those workers performing activities using needles and other potential sources of splatter may expose themselves to the aerosolized agents. The laboratory environment also contains non-biological materials, such as chemicals, which may pose a hazard to laboratory workers. When evaluating these chemical agents, they can be roughly divided into chemicals used for processing specimens and those used by the workers themselves. Examples of that first type of chemical include formalin, methanol, alcohol, and preservatives; and the second category chemicals might include cleaning solutions, disinfectants, and agents used in QC/PT programs. When handling laboratory specimens, personnel potentially encounter human blood, body fluids, and a variety of infectious agents. The routes of exposure include cutaneous contact, needle sticks, splashing, and inhaling infectious aerosols. These potential routes of exposure remain even if universal precautions are used, so protection from exposure is still necessary. Although the implementation of universal precautions has minimized exposure to bloodborne infections, the unexpected infection of a laboratory worker underscores the fact that there is still a real risk of exposure [6].

Bloodborne Pathogens

In the healthcare setting, laboratory personnel are frequently exposed to patient samples and are often in a position to share any number of these hazards. A routine but significant exposure indirectly experienced by many laboratory workers is that of chemical substances in the work environment, unless the use of some of these substances is protective equipment. In the laboratory setting, including research laboratories, X-rays, and radiation are also potentially harmful agents that deserve consideration. This chapter discusses occupational risk factors, the adverse health effects of these risk factors, and the occupational injuries faced by medical laboratory personnel. Examples of good safety and health practices for the laboratory are also included. Areas such as microbiology, hematology, immunohematology, and clinical chemistry have several potentially hazardous agents that range from biological materials to physical and chemical hazards [7]. There are many chemical hazards commonly found in the laboratory setting. Laboratory

personnel may be in close contact with an unknown level of biological material in the form of blood, saliva, cerebrospinal fluid, serum, or body tissues such as cervical tissue. In the hospital setting, laboratory workers are often asked to handle unknown body fluids that may contain blood borne pathogens, while workers in research laboratories may also handle contaminated nonhuman tissues such as those from animals used in research. Some communicable diseases that have highly positive results are often screened by blood testing. Consequently, laboratory workers like phlebotomists may suffer from cuts and needle punctures resulting in a break in skin integrity from contaminated needles or lags used in the collection of patient samples. Even after successful venipuncture, needle sticks caused by removing needles from the assembly for safe disposal, bites, and other breaks in skin integrity while processing the specimen follow collection as well. Since several needle sticks happen during collection or processing, the need for appropriate education, training, and practice methods before performing collection or processing is desirable [8].

CHEMICAL RISK FACTORS

This is one of the biggest dangers to laboratory personnel. Extremely toxic agents, such as the phosgene used in the immunological assay of biopolymers, the volatile organic solvents in rape basic haematology laboratory analyses, chemicals associated with citoanatomical structures, cultures of infectious agents, etc., and the carcinogenic, teratogenic dermoreactional agents and the mutagenic agents, require precautionary procedures and handling procedures. Among the most important standard precautions applicable to the handling of toxic agents and teratogenic dermoreactional agents, which medical laboratory professionals have to follow when they work with these biological poppas, are the following with respect to personal protective equipment, decontaminated contaminated biological risky materials, and the management of laboratory utensils and equipment. Infectious agents, especially bacteria, viruses, ricketsii, hard to grow mycobacteria, fungi, parasites, and a low number of oncological agents, have to be treated in the transportation, technical procedures, storage, elimination, and incineration of etiology. Such important agents have to be identified before they are manipulated. Occupational Risk Factors. In the clinical or hospital laboratories, only infectious biological entities that are considered to be a problem for those who manipulate them are previously identified. These are the infectious risk of microorganisms [9, 10].

Hazardous Chemicals in the Laboratory

The diagnosis and treatment of many diseases are established through medical laboratory tests. Medical laboratory personnel are exposed to many infectious biological materials and an increasing variety of hazardous chemicals. Germs are responsible for more occupational illnesses among medical laboratory personnel than are chemicals. Nonetheless, the number of laboratory-acquired infections reported each year is small with only a few instances of fatalities. Many pathogens that are not pathogenic if ingested can cause accidental injury if transmitted via a needle stick or broken glass to a worker. These pathogens, which cannot penetrate intact skin, will not cause disease percutaneous exposure except in the rare instances of a laboratory accident involving a deep cutaneous laceration with exposure to the pathogen, or if workers have skin that is injured or abraded. It is the infectious potential of these pathogens that poses a significant hazard to medical laboratory personnel. Furthermore, the big letter C that Loeb has written in his article propagates the idea that it is necessary to work in containment level 3 for viruses such as feline coronavirus that do not propagate and can only be transmitted mechanically [11]. There are sequences of some viruses for which there is no risk and the work is assigned wrongly. The use of hazardous chemicals is considered those chemicals included in the American National Standard selective medical-laboratory criteria. Clinical laboratories have other hazardous chemicals with some similar chemical characteristics, such as a low OSHA permissible exposure level, that have been reclassified under the OSHA Hazard Communication Standard in relation to the laboratory standard. According to a U.S. government survey, only 45% of clinical laboratories meet the laboratory safety standard and only 11% of laboratories include the required availability of personal protective equipment. Among the professions with

exposure to bloodborne pathogens, only the Occupational Health and Safety Administration level violation was found, lack of a required written exposure control plan. It is important to note that the maximum permissible exposure levels included safety factors to ensure recognition in standards that deal specifically with infectious materials, the reliability of tests used to assess exposure to biological hazards, and the evaluation requirements for any chemical. The actual pathogenic nature of the material to which workers are exposed in the clinical setting must also be evaluated. To further complicate workplace management of safety issues, chemicals as well as biological materials are often used in laboratory record complexes that describe the hazards. Then, a standard information system of all the data can be part of a hazard communication program that meets both chemical and biological standards. In addition, because employers must provide training in the recognition of hazardous chemicals for all workers as part of this program; this essentially means that training on both chemical and biological hazards is required for personnel who work with members of both groups of chemicals [12].

PHYSICAL RISK FACTORS

Physical Risk Factors. Laboratory professionals belong to a category of workers whose work involves frequent movements of their hands. Repetitive movements (repeated over 20 times per minute for extended periods) of the upper limbs are considered a key risk factor. Limited respect for certain basic principles of ergonomics can turn simple actions, such as pipetting and microtubing, into uncomfortable and awkward activities and can lead to serious problems in the hands, wrists, and forearms. Traumatic conditions are also associated with these activities, derived from sharp movements, falls, and transfer of vibrations through the hands from the equipment to which they are working. This is common in laboratory professionals and more frequently in laboratory technicians. Another factor that can result in hand alterations is performing activities with cold hands. Moreover, the routine of working in a well-controlled, air-conditioned environment leads professionals to neglect certain thermal risk factors [13]. The lack of information about the balance of the work environment in relation to posture for micro-pipette use discourages professionals from paying attention to the posture and alignment of forces. Some studies have reported discomfort and pain in the hands and forearms in undergraduate students, research participants, and professionals performing pipetting and/or micro-pipetting. Another problem is related to static posture and vibration. The cumulative effects of the exposure to the most common physical occupational risk factors, such as postural risk factors, repetitive movement, forceful exertions, or fixed, awkward postures, may become chronic, sometimes leading to the onset of musculoskeletal disorders in the laboratory workers. With reduced posture alignment, the location of the force in relation to the center of the hand or wrist of laboratory workers may increase the risk of musculoskeletal injury [14].

Ergonomic Hazards

The laboratory profession shares several work hazards with other professions; however, individual hazards are profession-specific. Hospitals and clinics provide healthcare services to the sick and injured, and some of these services are provided by medical laboratory personnel. While the laboratory provides quality data, its function relies on a high level of technical and physical competence from its employees. Testing must be completed under tight turnaround times, with the facility for backup being essential. Governmental regulations and standards are implemented to protect workers from the hazards encountered while performing their job duties. During the laboratory testing processes, hazards such as blood- borne pathogens, repetitive motions, latex allergy, translocation of infectious diseases, poisonous materials, excessive noise, heavy lifting, and radiation hazards are experienced [15]. A risk factor is anything that increases the probability of an adverse outcome. It suggests the likelihood of a hazard causing harm. Workers deal with various job- related stress factors daily. Some of these factors are non-work related, including their individual reactions to pressures, their lifestyles, and personal relationships. Some are environmental community-related factors, while others are associated with their work environment. These work-related stress factors vary among different professions, including

medical laboratory workers. The data derived from a study conducted by Taylor and Priff on the effect of occupational hazards on medical laboratory workers showed that participants have had exposure to ethylene oxide (100.0%), formalin (100.0%), isopropanol (98.8%), and acetone (86.5%). Pyridine, toluene, ethyl-acetate, xylene, and bleach are other reported chemical exposures. The same study also reported muscular stress, which also affects laboratory workers due to their repetitive tasks. The major factor described by Kim et al. also supports the results of Taylor and Priff, affecting laboratory worker satisfaction and motivation. These reports suggest that various laboratory workers are overworked [16].

Exposure to Radiation

Medical laboratory personnel are involved in the assay of a vast variety of radiolabelled substances to satisfy the demands of various healthcare professions. In addition, they accept radioimmunoassays demanded by private individuals. This surface contamination can result in radiation dose, especially when performing some manual tasks such as handling and carrying contaminated objects or when moving within a contaminated environment. External exposure is also possible when droplets or dust originating from a contaminated object impinge on the skin, with the part of the body to which the droplets or dust become attached receiving a radiation dose [17].

The highest radiation dose may be received through percutaneous punctures resulting from projected or dropped sharp sources of ionizing radiation. Besides these, an inhalation pathway is probable, especially when activities like mixing radioactive liquids and applying label injections are performed without local exhaust ventilation. Adequate precautions must be taken to minimize occupational hazards, such as radioactive contamination of the skin or wounds (e.g., lab coats, gloves, or forceps for handling sharps and two-way needle protection). The selection of workstations and laboratory equipment is also important. The effective use of this radiation safety infrastructure requires that laboratory personnel are provided with training and information on the radiation hazards and the corresponding safety precautions [18].

PSYCHOSOCIAL RISK FACTORS

Medical laboratory personnel may be exposed to psychosocial risk factors, either experienced directly or indirectly. These factors can result in a lower quality of working life, decreased job satisfaction, increased turnover of staff, or higher rates of employee absenteeism. The types of psychosocial risks that threaten medical laboratory personnel can manifest in various ways. Some of these factors include excessive workload, unpredictable work schedules, inadequate training, and a lack of career growth. These issues seriously affect the performance and well-being of healthcare workers. Linking empirical findings to the conceptual framework provided by the job- demand-control model (JDC model) and using a sample of 284 medical laboratory professionals, it was shown that medical laboratory professionals usually report high levels of workload and inadequate staffing. This causal conflict requires conflict management, low social support, autonomy, and job stress. Job stress has become a cross-cutting issue in all sorts of medical-based working contexts. Medical occupations, with their inherent features, are considered particularly at high risk of job strain, which can lead to affective, emotional, and personality disorders. This risk could lead to potential empathy loss in care professionals. It is, therefore, of paramount importance to approach the psychosocial risk factors experienced by these professionals in order to enhance empathy behavior among medical professionals [19]. In this regard, medical laboratory professionals are no exception. Items assessing the perception of empathy on a Measure of Empathy in Health Care Professionals by professionals showed not only significant differences between respondents depending upon their years of work experience and type of laboratory studied but also how scores on certain psychosocial risk factors are related to empathy. Data, therefore, attest to the importance of job-related psychosocial risk factors in the maintenance of professionals' empathy behavior, a point previously noted by other authors [20].

Work-related Stress

Work-related stress and overload are related to all negative aspects of job characteristics: nurses' dissatisfaction with their work, their desire to quit their job, and ratings of excessive

work demands. Nurses' dissatisfaction with both work conditions and the salary situation predicts their intent to leave their current job. Increased work-related stress, overload, and excessive work demands also contribute to increased growth in work-related stress, overload, and excessive work demands. This confirms the results of international studies that show the role hospital nursing and work overload have in the distress experienced by personnel in the care of citizens. Work-related stress in nurses has been widely described worldwide. Several sources of stress have been proposed. One major area of concern is the healthcare setting in which nurses work. A study conducted in Italy to assess job satisfaction, perceived work-related stress, and intent to leave in disappearing professions found that nurses in hospitals that are more often large general hospitals locate them as in the disappearing profession group. This result is not surprising since nursing in Italy, as in other western countries, is frequently associated with a young average age and the new generation of nurses avoids working on the wards. Therefore, the hospital experience becomes an opportunity for formational and work-related stress, and this may induce nurses to position their job in the disappearing professions group. In this scenario, concrete initiatives to affect the fragility of the healthcare profession appear necessary. Based on these results, it is appropriate to design specific programs to attract and retain nurses to these hospital areas.

Shift Work and Fatigue

A discussion of shift work in the medical laboratory cannot be undertaken without a mention of fatigue. Shift work typically involves healthcare professionals working well beyond the "normal" 7 am-5 pm hours. This is true for many staffing positions in the hospital as well as nursing, but many medical laboratory professionals are scheduled for overnight rotations. Work performed during the overnight hours must receive the same careful attention as that performed during the day, and in many other businesses and services, night shift workers receive shift differential because it is well established that working at night is associated with significant health and social consequences. Hematologists report delayed reaction to fatigue and reductions in cognitive abilities for overnight work when the percentage of task completion exceeds 55% compared with workers with daytime schedules. Gradually reduced information processing was observed with each six-hour reduction in "natural light exposure," independent of the start time of the workday. While not unique to medical laboratory workers, risks of fatigue contributing to user error with a task like correctly interpreting a DNA gel are both real and career-changing. Fatigue, insufficient recovery time, lack of control over one's schedule and duties, and little input into the organization's processes are strain factors that have been associated with reduced job satisfaction and physical well-being. Laboratory staff accustomed to 8-12 hour rotating shifts have circadian rhythms adapted to their schedule, but struggles include building up fatigue over a 24-hour extended shift, as well as insufficient recovery time after these long shifts. Additionally, individual tolerance to nights and to morning rushed starts is variable. Laboratory directors should be aware of the consequences of long work hours and design schedules according to employee preferences. Circadian rhythms employed as a tool for scheduling appear as a clear need waiting to be explored. Shift rotation policies should be addressed and "the concept of shift work" should include consistency and control of work hours. In the meantime, no matter how inevitable night shifts may be, learning coping strategies to adjust to these schedules is the responsibility of the employee. Small meals more frequently, scheduling activities for daylight hours, and following an exercise program assist in managing the risk of fatigue.

PREVENTIVE MEASURES AND CONTROL STRATEGIES

Many strategies and control measures can be taken to reduce or prevent the harmful effects of occupational risks and hazards facing medical laboratory personnel. The ABCs of prevention and control to prevent any occupational risk or hazard at workplaces include the following measures: provide information to employees about hazards in the lab; implementing safety and health programs; education and training - instruct technicians on how to protect themselves, what actions to take in case of an accident, how to report adverse incidents; using engineering controls: isolating hazardous

materials from laboratory technicians with, for example, a fume hood, and creating labor levels that create barriers to protect from fume leakage and limiting chemical use; using work practice controls and standard operating procedures: hand washing, good laboratory hygiene, not eating or drinking while working, and housekeeping and care of work areas. Decontamination of equipment and environmental cleaning reduces the accumulation of hazardous chemicals on equipment and environmental surfaces; following administrative controls: implementing and enforcing federal, state, and local laboratory standards; following proper labeling protocols in the use of safe sharps; reporting all workplace injuries or illnesses; maintaining occupational medical surveillance; providing hepatitis B vaccinations; disposing of contaminated material properly; and using Personal Protective Equipment (PPE), such as chemical aprons, gloves, respirators, shoe covers, and safety goggles. Any time technicians take action to protect themselves from direct contact with hazardous substances, they are using PPE. Common PPE includes gloves, aprons, overcoats, goggles, and face shields, lab coats, and respirators, which are important to use when products are being opened, manipulated, cleaned up, or discarded. Goggles/facemasks are used whenever the possibility exists for chemical splashes to enter the eye or come

in contact with the facial area. Whenever broken glass, blood, or body fluid spills occur, the use of gloves is advised. Overcoats and aprons are appropriate when large amounts of chemicals or dust are generated, and the use of lab coats is suggested when working with chemicals in a laboratory.

Personal Protective Equipment

Nurses and doctors use gowns, masks, face shields, and gloves to protect their clothing and skin and to prevent the spread of infection. Wearing personal protective equipment during patient care also protects the health of medical laboratory workers. Face shields and fluid-resistant splash aprons should be worn by personnel who are working with patient specimens in a doctor's office or at the bedside to collect blood specimens or perform fingerstick testing. Face shields, laboratory coats, gloves, shoe covers, respirators, and eye protection should be worn by medical laboratory workers who perform any aspect of SARS testing. Patients who are suspected of having the SARS virus should be equally protected with infection control measures. Universal precautions should be followed for all laboratory specimens obtained from patients, whether they are being tested for suspected infections or for non-infectious diseases. All medical laboratory personnel should wear gloves when handling all kinds of patient specimens, especially when sorting, opening, and centrifuging blood collection tubes unless the test requires the serum separator tubes and the yellow/yellow tiger top blood collection tubes. Powder-free latex or non-latex gloves should be worn by employees who process the chemical reagents and process the washed reaction trays. Eye protection should also be worn when there is a possibility that specimens might splatter or cause the release of aerosols. An outer garment should be worn to protect the employee's personal clothing from contamination. For safety reasons, laboratory coats should be made from fabric that resists and repels fluids. Medical laboratory workers should also wear gloves when they inspect, wipe clean, and count the control material, and in the performance of worker-related quality control tests. Technicians should automatically don a lab coat and gloves as part of their step-wearing Personal Protective Equipment (PPE) that is worn after completing hand washing and/or may be removed after being used in the performance of duties. However, when they leave the area of service, they should dispose of the gloves, clean their hands, decontaminate other PPE used, and put on fresh gloves before they return to work in the medical laboratory. The used gloves should be deposited in a waste receptacle by tying them into a knot to prevent them from dropping from the pail after the garbage bag has been removed.

REGULATORY FRAMEWORK AND GUIDELINES

This section describes regulatory mechanisms and international and regional guidelines or recommendations on occupational hazards in the clinical laboratory and risks facing medical laboratory personnel.

Regulatory Mechanisms

Regulatory mechanisms control occupational risks associated with laboratory work to some

extent in most jurisdictions. The control of harmful agents in the workplace varies by country, from mere recommendations to regulations with penal implications. It has been observed that as many guidelines as there are, a level is respected as the one to do. Therefore, working within the recommended limits may be acceptable to ensure employee health and safety. Violating recommended exposure limits without provisions for an increase in their health surveillance or biological monitoring of biological exposure levels is generally unacceptable if the exposure is related to the risk of the work and to subsequent health effects.

International and Regional Guidelines or Recommendations Although not legally binding, the guidelines provide valuable advice to laboratory

Management and workers who are expected to apply them. The list below is indicative and may not be exhaustive, a site may have other rules like. The main guidelines come from the WHO, the International Labour Organization (ILO), the World Medical Association (WMA), the United States Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), the National Institute for Occupational Safety and Health of the United States (NIOSH), the Equal Employment Opportunity Commission (EEOC), the Occupational Safety and Health Administration (OSHA).

CASE STUDIES AND STATISTICS

The medical laboratory industry, as part of the broader healthcare sector, has not received nearly as much attention to the occupational health and safety of its workers as other healthcare delivery personnel. Despite the considerable strain and demands related to such activities as patient testing and results reporting made on this group of healthcare workers - Medical Laboratory Personnel (MLP) - a literature review failed to identify significant academic and governmental research. The literature draws attention to the primary enterprise of the medical laboratory: patient diagnosis (e.g., blood tests) on behalf of the Healthcare Professional (HCP). However, scant attention has been paid to the many secondary activities like fundamental quality assurance and internal laboratory verification procedures, preventive maintenance procedures, elementary laboratory housekeeping, or adherence to substantive legislative requirements (e.g., WHMIS Regulations).

Aggregate health and safety statistical resources are not available that either support the convergence assumption or provide solid data on which essential safety standards can be developed. Proximal case studies still need to reveal the extent of potentially related activities capable of determining failure. Subsequent identification of causal factors associated with substandard performance, which could lead to intervention and remediation strategies, is required. Regulations/minimal standards other than designation of a regulated occupation concerned with specific safe workplace practices are conspicuous for their absence. Limited attention has been paid as well to the use made of administrative data gathered at the provincial/state level, to draw widely applicable conclusions concerning occupational safety levels for the referred to industry. It can be argued that numerous factors are responsible for the dearth of attention given to the occupational health and safety problems facing MLP. These include a lack of prioritization of what is considered important, perceived absence of significant harm, a myopic focus on the delivery of safe test results to external clients in the shortest time possible at the lowest price, a hidden workplace environment, and defining the employment of inherently occupational hazards as the ordinary components of a commonly accepted, blue-collar work environment. Clearly another factor is responsibility, in that federal, provincial/state, and territorial governments have to date generally deferred establishment of any regulated work standards to the medical laboratory professionals themselves. Prescribing physicians - the clients of MLP - have overlooked the importance of the health, safety, and welfare of MLP, frequently contracting out the service at the lowest possible price. NPPO (officially reported negative values) in the literature, when applied directly to the Safety and Health Staple Point within a broader Operative Renewal framework, demonstrate this absence of prioritization. Given the significant regulatory void, benchmarking safety levels within the referred to industry has not taken place. Differences in safety levels have not been referred to for validation. Rescue plans or safety nets at the provincial/state level are also non- existent.

FUTURE RESEARCH DIRECTIONS

While the following research areas are potentially unfailing areas for future research, they should still be viewed as challenges for research priorities based upon recent changes in the workplace that have encouraged laboratory automation and other changes likely to ameliorate the occupational risks for most laboratory workers. Laboratory automation also has the potential of making the monitoring process more complex, thus increasing cognitive stress. More information is needed concerning many potential adverse health outcomes that have yet to be studied in or validly measured on laboratory personnel. The basic research on the nature of the stress that many laboratory personnel say is the most important problem at work has yet to be conducted. This has blocked the development of detailed intervention plans. 12-hour shifts are growing in importance among laboratory personnel; however, no recent studies have focused on the health and safety effects of 12-hour shifts in the laboratory. For many years, research has suggested that the weeks worked per year is an important predictor of absenteeism and health symptoms. However, studies of recent laboratory personnel suggest that they work about the same number of weeks a year as workers in other occupations. There are at least two explanations for the difference in research findings in other occupations.

CONCLUSION

The medical laboratory has changed many times since its origins, becoming quite different from those early specialists. Medical laboratory personnel are indispensable for the proper functioning of the laboratory, since they interact with many complex instruments, computers, and other devices. As a group, the medical laboratory personnel have developed a good record in terms of common chronic conditions and fatal injury, probably due to the nature of their work. The specific increased risk of HIV and hepatitis infections represents a special risk unique to this occupation. Most of the professional actions that can prevent or minimize exposure to HIV and other blood-borne pathogens are universal precautions, from the Occupational Safety and Health Administration (OSHA). The OSHA's Blood-borne Pathogens Standard and the U.S. Center for Disease Control and Prevention have generated guidelines for the protection of health care workers from exposure to blood. These guidelines create duties for the employers, such as the implementation of an exposure control plan, to evaluate what tasks might expose employees, to determine whether it is feasible to reduce these tasks or decontaminate blood-contaminated clothing or equipment. Although hazards exist near, they are not confined solely to the field of medical laboratory personnel. Public health personnel, autopsy personnel, public order personnel, and emergency medical personnel are all health care workers at risk for HIV and other infectious diseases caused by blood exposure. These workers, like those in the laboratory, might encounter only small injuries that may have occurred without their use of instruments. The medical laboratory workers of diagnostics are assistants, blind followers/ performers, and not interpreters of laboratory data; they give their inputs with risk. However, without their accomplishments, it is impossible that the patients obtained better clinical services, including longer and healthier lives.

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