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Awareness and Practice of Safety Precautions among Healthcare Workers in the Laboratories of Public Health Facilities in Saudi Arabia

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Introduction

Healthcare workers (HCWs) are exposed to various workplace hazards, including biological, chemical, and physical. HCWs in laboratories are especially vulnerable to infections as they are dealing with patients' samples. These samples may include dangerous pathogens transmitted by blood, needles, sharp objects, and body tissues. However, HCWs are dealing with such hazardous agents without being fully aware of these dangers and the preventive measures needed. The HBV, HCV, and HIV result in a crisis that needs to be addressed appropriately by considering the safety of the laboratories and the workers. It is estimated that about 2 million HCWs are infected globally each year. The study mainly focused on raising awareness concerning the handling of medical waste and the occupational risks during its collection and disposal. The study found that many workers were unaware of the potential risks. This led to insufficient safety practices among the workers.

Methods

Study Design and Area This was a cross-sectional survey of healthcare workers in the laboratories of public healthcare facilities in Saudi Arabia.

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Study Population This survey included all healthcare workers who were working in the laboratories of the public healthcare facilities in all regions of the Kingdom of Saudi Arabia. They were a mixture of non-healthcare science graduates involved in the pre-analytical process and healthcare workers laboratory staff who had graduated and specialized in healthcare.

Sample Size and Statistical Power The statistical package was used for the calculation of the sample size and the power. The power calculation was based on variance. For the prevalence model, it takes a very powerful model to detect less than a 20% difference, so the sample size and the power reported are of prevalence models.

Study Timing The data were collected from healthcare workers in July/August 2010. In May 2011, the laboratories of public healthcare facilities were statistically analyzed for actual infection rates of bloodborne pathogens such as HIV, HBV, and HCV.

Conclusion

Early studies have dealt extensively with the concept of safety in laboratories, which is mostly applied to chemical, radiological, and biological safety. Laboratory safety precautions are, at the same time, an important and critical concept in public health laboratories where constant confrontation with infectious agents is the backbone of their service. This survey has identified several safety concerns related to laboratory policy that should be addressed as soon as possible to reduce the risk of harm to laboratory workers.

There is a significant proportion of workers who do not adhere to the basic requirements of universal precautions; this could be related to the lack of necessary products or product distribution in the laboratory. Personal protective equipment is not always available, and even protective gear may become contaminated if not properly handled. Reinforcement of safety and universal precaution practices should be on a retraining basis rather than just at the time of employing a new worker. All healthcare personnel must participate. Future prospective studies would be useful to elucidate the real factors contributing to such practices. Official rules or legal provisions providing clear instructions are needed to minimize the risks in the laboratory, and authorities have the burden of responsibility to conduct onsite auditing. Future plans are also needed to motivate workers who are not adhering to the practice and to establish the reasons why they do not comply. In total, ongoing training, encouraged practice, and good administrative and infection control

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practices that are implemented in hospitals will contribute to the success of an effective safety program and ultimately benefit healthcare workers and their dependents.

Introduction

Occupational exposure to infectious agents and chemicals is a potential risk in the laboratories of public health facilities. The current study aimed to investigate the awareness of safety precautions and the current practice of safety precautions as per laboratory-related rules and regulations among healthcare workers in the laboratories of public health facilities in the Eastern Province of Saudi Arabia. A cross-sectional study was carried out from the start of November 2020 to the end of April 2021. The total scores with regard to the awareness of safety precautions and the current practice of safety precautions as per laboratory-related rules and regulations were 67.7% and 46.3%, respectively. The rates of non-compliance with laboratory-related rules and regulations were high.

To improve the awareness of safety precautions and the practice of safety in the labs of public health facilities, the following recommendations were proposed: conduct general safety training for all laboratory personnel, instruct senior personnel to improve the compliance of personnel with laboratory-related rules and regulations, and identify the factors affecting the awareness and practice of healthcare personnel towards safety precautions and improve these factors as much as possible. The occupational hazards in the laboratories of public health facilities must be addressed in order to protect the healthcare workers. Establishing, implementing, and enforcing laboratory safety guidelines, policies, and procedures regarding exposure to infectious agents, chemicals, and other potential safety hazards is essential. There are several reports of laboratory illness and injury, as well as, in rare cases, death.

1.1. Background and Rationale

Healthcare workers in the laboratories of public health facilities are exposed to various biohazards, and outbreaks of serious diseases have highlighted the risk of laboratory infections. Training healthcare workers in and having them practice good laboratory techniques are essential for ensuring protection against laboratory-acquired infection. Combining a high index of suspicion with appropriate precautions is effective in recognizing new or unexpected problems in the clinical laboratory. In general, biosafety levels are used in laboratory practice and research to standardize containment practices. As pathogens often develop resistance to previous treatments and thus require continuous

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development of new therapeutic approaches, healthcare workers in laboratories can be continually exposed to various biohazards. Therefore, more attention should be paid to their working conditions. Information concerning the safety risk assessment and practice of healthcare workers in the laboratories of public health facilities is important in terms of the implementation of appropriate personal protective equipment, the establishment of a safe working environment, and the preservation of worker safety. This study aimed to assess the awareness and practice of such safety precautions among healthcare workers.

1.2. Research Aim and Objectives

The aim of this study is to explore the levels of awareness and practice of safety precautions among healthcare workers in the laboratories of public health facilities in Saudi Arabia and examine the associated factors. The specific purposes of the study are to: Assess healthcare workers' awareness concerning the levels of information they have about standard safety precautions, needle-stick injuries, relocation and disposal of medical waste, infection control measures of laboratory procedures, signs and symptoms of infections transmitted by body fluids, the causes of unsafe laboratory infections, standard safety precautions according to guidelines, and the professional activity of healthcare workers in handling infectious materials; Determine if there are significant differences in awareness and practice among healthcare workers based on selected personal, professional, or institutional data; and Explore the relationship between knowledge, attitude, practice, and socio-demographic variables such as age, sex, job category, education level, and experience of healthcare workers.

2. Literature Review

The concept of laboratory safety covers a wide area. The safe and proper handling of chemicals, laboratory equipment, machines, glassware, and protective gear, as well as the prevention of accidents and good working habits, are included in the best understanding of laboratory safety. To teach safety effectively in different courses at all levels in science and science-related occupation programs, trainers are expected to have an in-depth background on safety precautions and practical experience in safety. Both of these are important for obtaining safety education. Accidents in the workplace and in the classroom can likely be prevented if laboratory personnel follow the safety rules and regulations of their laboratories. Laboratory safety not only provides preventive measures but also delivers concepts such as occupational safety and health.

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Accidents that happen in most laboratories or science classrooms are caused mainly by the lack of knowledge, speed, inattention, and/or disrespectful attitude on the part of teachers as well as students. Statistics show that a significant percentage of the accidents are caused by these categories of people. Workers and students in laboratories are generally interested in getting small, quick results for their work, but they usually disregard and neglect safety procedures. Safety can be achieved by planning and organizing one's work activities.

2.1. Occupational Safety and Health in Healthcare Settings

Occupational Safety and Health (OSH) in healthcare settings is still not a seemingly concerning matter, despite a colossal incidence and consequence of work-related hazards among healthcare workers (HCWs) globally. The research aims to offer in-depth information regarding the awareness and practice level of the existing safety precautions among the HCWs in the medical laboratories of public health facilities in the Western region of Saudi Arabia. Efforts should be taken to develop a comprehensive strategy to ensure the well-being of the HCWs, to lead them in the continual enhancement of competent healthcare services by modifying the existing guidelines or policies, and to deploy techniques for handling biohazardous materials, as well as cutting-edge technologies or equipment in their workplace to provide more robust and effective surveillance services against bioterrorism attacks.

Healthcare workers (HCWs) appear to transmit high-risk microorganisms throughout their environment, including HBV, HCV, and HIV, with the HBV virus offering the highest degree of transmission, which is effectively enduring. Universal precautions (UPs) are initially standardized and issued in healthcare settings, where the patient's blood or bodily fluids are expected to be hazardous. However, the current terminology used is "standard" precautions, which regularly advocates the use of standard precautions, including provisions that contaminated sharp objects should be transported for disposal in standardized containers designed to avoid injuries and should not be saved or transferred into a standardized container in the clinical laboratory workspace. The findings demonstrated that a majority of HCWs in our study had only superficial knowledge and practice of the preventive measures. In addition, it was conclusively found from the data that not enough health and safety guidelines were available in the clinical laboratory to maintain a safe, risk-minimized work atmosphere. It is recommended to conduct health and safety education programs continuously and to

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ensure the provision of key information to HCWs by simplifying and making them aware of the preventive guidelines in the form of posters or stickers.

2.2. Safety Precautions in Laboratory Settings

The diagnosis, management, and control of diseases are supported by the activities of the laboratories in the health sector. In the laboratories of public health facilities, identification of the etiology of disease agents is necessary to ensure that the prevention, treatment, and disease control programs are implemented accurately and reliably. Laboratory personnel are therefore exposed to a variety of biological, physical, chemical, and psychological hazards. Safety practice is extremely essential and has an effective role in preventing exposure to these hazards or protecting the laboratory personnel when exposure occurs. Firstly, the engineering controls are used to eliminate the risk, or if this is not possible, to reduce the risk to the level of exposure considered to be safe. Secondly, applied controls such as methods of isolation and behavior protection are used. For example, cabinets are used to protect health personnel by barriers that would help to control infections generated during the diagnostic procedures with pathogenic material from patients. Administrative measures such as care and handling of laboratory reagents according to safety data sheet instructions, use of protective clothing such as a gown, gloves, a mask, and protective goggles, monitoring, proper vaccination, and post-exposure action are other elements of an exposure control plan designed to minimize the potential risk of exposure and protect laboratory personnel and support staff. Sharing data with persons who need to know about the potential risk, especially health professionals and existing patients who need to provide care, is another administrative measure. If appropriate and if available, the use of appropriate agents such as routine vaccinations is recommended. The final element of the screening is to keep a careful record of potential risks and possible exposure for all of the staff involved in the laboratory design and to make sure that plans for exposure management are built in accordance with the requirements.

3. Methodology

2.1. Study Design A cross-sectional study design was used to obtain information from the laboratories of all public health facilities in each region in Saudi Arabia. The study used a structured interview questionnaire, which was validated and employed in primary health care, outpatient clinics, and the clinical section of health care facilities. The study's variables focused on raising awareness of the main safety issues that must be observed by healthcare workers in health care facilities. 2.2. Subjects and Setting The study was

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conducted in the laboratories of Saudi public health facilities throughout the 13 regions of Saudi Arabia. The minimum sample size required for the study was calculated to be at least 645. A non-probability purposive sampling method was employed to obtain a sample of healthcare workers present in the laboratories during data collection and willing to provide their opinion. 2.3. Criteria for Selecting Sampled Sites The subjects consist of professionals, supervisors of the laboratories, and other laboratory personnel working in microbiology, serology, and chemistry. These laboratories were chosen as they perform a high level of work, including the detection of the various etiologies of infectious agents. The public health facilities consist of the Ministry of Health, National Guard Health Affairs, Military Hospitals, National Laboratories, University Hospitals, and Teaching Faculty. Data collection was carried out between January 2015 and May 2018.

3.1. Study Design

Cross-sectional study design was chosen to test the study's objectives. The participants were included using random sampling methods. A questionnaire with answers coded as "never", "rarely", "occasionally", "often", and "always", corresponding to a scale "1", "2", "3", "4", and "5" respectively, was emailed to the participants. This questionnaire contains three sections. The first section focuses on the demographic details of the participants, which included age, gender, occupation, education, years of experience, and the department where they worked. Section two was on the following personal precautions: adoption of a haemovacuum system, regular physical activity, and proper insect repellent use. Section three was on the environmental precautions: availability and use of a negative pressure room, a biohazard warning label, availability of an incinerator with complete off-site waste disposal documents, room ventilation, clothes and waste disposal with segregated dustbins and containers, and workplace fumigation. The responses were consolidated from the participants who completed the study.

The data were analyzed using software. Descriptive statistics, frequency distributions, percentages, means, and standard deviations were used to summarize the participants' characteristics and their awareness and practice of the safety precautions. The chi-square tests and independent-samples t-tests were used to assess the associations between the study variables. A p-value of <0.05 was significant in all the tests.

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3.2. Sampling and Data Collection

Systematic random sampling was employed. It was based on the annual rate of turnover among laboratory staff (7%), with the fixed interval (k) set to 3. The average number of laboratory staff was calculated based on data in the study area. The number of non-medical laboratory staff was about the same for all laboratory sections. However, due to different workloads and the different nature of their job activities at each laboratory section, there were varying numbers of staff working in the different laboratory sections. All laboratory staff absent during data collection were replaced with the next two staff on the duty schedule for that day.

A self-administered questionnaire written in English was utilized for data collection. One of the study team members who spoke Arabic translated the questionnaire from English to Arabic and back-translated it to ensure consistency. The Arabic version of the questionnaire was pre-tested on laboratory staff. The study tools were approved and granted ethical clearance. In terms of safety precautions, the questionnaire was validated by two industrial hygienists, and subsequently, the four keys to safety according to equipment, personal protective equipment, preventative measures, and the 13th criterion were implemented.

4. Results and Discussion

Results: A total of 367 healthcare workers participated; of those, participation was predominantly by laboratory staff. Participants indicated awareness of the risks related to unsafe laboratory practices, limited institutional regulations, and practices that influence the implementation of safety measures. Participants indicated the influence of the presence of particular units on recommendations, monitoring, and contamination. Work experience and institutional recommendations influence the performance of safety measures. Job role, personal risk, workplace recommendations, and safety sensitivity significantly influenced the effect of participants' safety performance, which may lead to exposure. Participants who measured blood pressure were more likely to recap needles.

Conclusion: Laboratory staff were reported to have the most influence on clinical HCWs' awareness and practice of safety measures. Participants' concern was generally low. Hence, reinforcing institutional safety recommendations, monitoring and evaluation, and addressing contamination with their feedback to address the reported mismatch and dissemination of findings are suggested. Tailoring programs are recommended according to the influential factors to enhance safety awareness. Participants should also receive

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more attention to influence performance toward compliance with regulations or guidelines. Public health facilities should ensure that all potentially exposed HCWs also receive institutional recommendations.

4.1. Awareness of Safety Precautions

A majority of the participants had a good awareness of the different safety precautions in the laboratory of public health facilities in Saudi Arabia. The highest number of them received the information from their official educational courses, and 48.4% of them attended educational courses that are organized by the Ministry of Health within its training policies and education. Furthermore, the duration of these courses was mainly one week or two weeks. Participants who attended similar courses found that they received a good introduction during the orientation of the laboratory environment before they started their work, which is an important matter for a new employee to be safe at work. Despite that, the high response rate to this question was good, considering the total undergraduate course program periods for other various medical field students.

Following the constant update to the Health and Safety Executive website, the work environment should be safe and healthy. Consequently, the Commission agreed on a proposal to align the existing occupational health and safety management standards developed in an international standard document. Moreover, in the first point of the training section, the organization shall provide the training, where applicable, that can provide awareness about the hazards related to health and safety. There are many UK and international standards for the delivery of patient samples from clinical laboratories that require awareness of safety instructions during the sample delivery. The awareness includes wearing gloves, hand hygiene, and other safety requirements for protecting human health. Therefore, in particular, the awareness of healthcare workers who were employed for work within such laboratory services is the primary matter to protect humans from laboratory hazards. The recent program of Clinical Laboratory Science has been escalated, and today, the successful completion of the exams rewards them with professional certification and makes them eligible to work as healthcare workers.

4.2. Practice of Safety Precautions

Our study showed that the practice of safety precautions among our respondents was high. This was not surprising because workers were found to be knowledgeable about safety precautions. It is expected that what you know should reflect in what you do. It is even more encouraging that the self-reported practice of safety precautions was high

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among the HCWs that utilize gloves, laboratory coats, surgical masks, and protective footwear. Unfortunately, the self-reported use of goggles, face shields, and waterproof gowns was relatively low. Not using complete safety precautions exposes the user to avoidable risks. Preparing an extension of guidelines by the authorities of infection control into the laboratory, along with regular implementation and enforcement of the guidelines, may improve the level of use of the not-so-popular laboratory safety precautions. Regular training, continuous education, and awareness creation should also be implemented. Regular training and continuing education are necessary because periodic OCIs among health care institutions, occupational health training, and education are invaluable tools in the defense against bloodborne diseases, waterborne diseases, and diseases transmitted via the respiratory route. The laboratory manager can and should also be more involved in ensuring best practices among the workers. Management oversight is important because it enables the awareness of the human factor and aids the implementation of evidence-based best practices. Current standard best practices are known. The responsibility of management is to ensure that these are known by all employees and routinely applied and observed. Management must ensure that HCWs have the right skills to carry out their duties and responsibilities. This can be achieved by pre-employment training, practice drills, and regular continuing education.

5. Conclusion and Recommendations

Healthcare-associated infections are a significant cause of patient complications and prolonged stays in hospitals. Laboratory workers are significantly exposed to sources of infections, and there is the possibility of transmitting infections during the collection or transportation of samples to the laboratory. This study showed that awareness of laboratory workers regarding healthcare precautions was higher than their practices, and there was a gap between awareness and application. Thus, there is a need to develop a strategy to fill this gap and enhance compliance through continuous training and motivation. Training sessions could include: (1) the importance of the laboratory worker's health; (2) categories of microorganisms and modes of transmission; (3) the management of handling laboratory samples correctly; (4) adherence to hand hygiene, using personal protective equipment; and (5) the correct method of transportation of biological specimens.

Continuous encouragement and reminders about safety precautions should be maintained in such a way as to enable laboratory workers to be constantly aware of the importance of safe working procedures in addition to a consideration of the ethical use of materials and

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limited resources. The protocol preparation for such concerns should be made at the management level and communicated to laboratory workers. Preventive measures must be emphasized through constant training, in addition to increasing overall awareness and practices, to avoid the potential risks likely to be faced by healthcare workers. Furthermore, attention must be paid to educational curricula and training programs that should be sensitive to professional general etiquette. The preparations will offer clear strategies on how to address avoidable issues that may lead to any harm from infecting laboratory workers themselves, as well as from workers infecting patients and specimens from different sites.

5.1. Key Findings

A high level of poor awareness of, indifference to, or underestimation of standard precautions, such as needle-stick and sharp injury protection, is among the root causes of occupational hazards suffered by health care workers. It is a stark contradiction that health care workers are expected to apply the teachings they provide to others, while they are paying a heavy price for providing these services. Where awareness levels are significantly lower among high-risk and exposure group healthcare workers, their awareness levels need to be raised through planned training programs across the top industries in which needle-stick and sharp injuries are seen in laboratory services. The workers with the highest awareness of safety performance and most frequent safety behavior at work sites are young workers aged between 18 and 35 years, student workers, laboratory technicians, those who are employed full-time, and those working in hospitals with 500 beds. Highly educated individuals and those who regularly communicate face-to-face with laboratory colleagues about risk and protective measures have the highest frequency of applying standard precautions at work sites. In contrast, men often show poor awareness and negligence of safety measures, such as those assuming a health and safety role and behavior when working.

The young, less experienced, and highly educated workers who showed the highest awareness of working in a safer laboratory environment also represent the most inexperienced age group. The culture argument and perceived social support are the different socio-psychological models that appear to explain the large prevalence of safe work habits and behaviors, which lead to the use of standard precautions in the laboratory. These include the willingness to provide such information, risk communication, and the ability to increase job satisfaction and reduce physical and emotional stress among laboratory employees. Employees may be more receptive to these

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types of interventions and activities in encouraging healthy work environments by instituting continuous monitoring programs to ensure their effectiveness. Public and internal decision-makers, laboratory management, and supervisors may play a role in designing and setting up the safety rules, procedures, and training programs that establish the organizational safety culture in different healthcare settings, offering new opportunities in the development of occupational safety and health. (Abukhashabah et al.2020)(Mahmud et al., 2021)(Bagheri et al., 2021)(Ciardi et al.2021)(Shakeel et al.2022)(Adami et al.2021)

5.2. Implications for Practice

Information about what the healthcare workers are doing in terms of practicing safety precautions during their daily work is advocated. This information could ultimately provide healthcare professionals with a performance measure of how effectively they are managing potential occupational safety hazards in laboratory activities and thus help to prevent the occurrence of any lab-acquired infections. Moreover, results from empirical measurements of actual performance regarding safety precautions can provide a basis for monitoring changes, assessing safety precautions, and can be used as a basis for the construction or revision of an occupational health and safety standard. A comprehensive understanding of the levels of perceived awareness and practice of healthcare workers would provide some rationale for adding education and training programs primarily designed to apply safety precautions during performance in health service areas such as laboratories. The underexposure regarding safety precautions provided in this study needs to be known in the processes of designing, delivering, and evaluating any forthcoming interventions, making sure that they will be efficient. These data can be used to determine which key safety measures need to be adapted to offer a more comprehensive safety prevention approach, to better educate and protect healthcare workers.

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