

Assessment of Biosafety and Biosecurity Aspects in Diagnostic Clinical Laboratories in Tripoli, Libya

Ben Ashur A¹, Wahed E¹, Magrahi H¹, Najla Elyounsi¹, Annajar B²

1) Department of Medical Laboratories Sciences, Faculty of Medical Technology, Tripoli University, Tripoli, Libya.

2) National Centre for Disease Control, Ain Zara, Tripoli, Libya.

Email: Najla.Elyounsi@yahoo.com

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ABSTRACT

Background: Biosafety and Biosecurity are fundamental practices in the laboratory settings, especially, in developing countries, where standard operating procedures (SOPs) are generally low. **Objective:** To assess the situation and examine policies and standards that laboratories apply to ensure biosafety and biosecurity in their settings, and to eventually come up with number of recommendations on how to implement biosafety and biosecurity procedures.

Methods: The study was conducted during the period from November, 2016 to April, 2017 in 10 public hospital laboratories and 25 private diagnostic laboratories in Tripoli, Libya. **Results:** The results in this study found that 64.8 % of laboratory technicians have used gloves and lab coats and only 30.6% of participants had their recommended vaccines. In addition, accidents during specimen centrifugation were observed in 81% of all laboratories surveyed. Furthermore, separate bins for sharps, procedures for disposal of liquid biological wastes, appropriate chemical waste containers, and appropriate methods (i.e. autoclaving, chemical etc.) to decontaminate all biological culture media were not observed in 77.6%, 82.1%, 46%, and 56.1% respectively, of all audited laboratories. Moreover, presence of biohazard signs on door entrances, written standard basic operating procedures (SOPs), biosafety cabinets, programs for medical surveillance, accident records and biosafety training were not available in 85.7%, 56.1%, 79.1%, 80.1%, 82.6%, 88.3%, respectively, of all laboratories surveyed. **Conclusion:** This study concluded that the level of biosafety and biosecurity measures in all laboratories surveyed were noticeably low. Moreover, the awareness of laboratory staff and technicians to proper laboratory practices was not generally predominant.

Keywords: Biosafety; biosecurity; clinical laboratories; assessment; perception.

INTRODUCTION

Biosafety and biosecurity are considered to be the essential practices which should be constantly implemented and enforced in all bioscience research settings and diagnostic medical laboratories around the globe. The World Health Organization (WHO) has long recognized that, safety and, in particular biological safety is an important international issue ^[1], especially in developing countries where standard operating procedures (SOPs) are generally low ^[2]. Biosafety is complementary to biosecurity and both concepts are essential to protect laboratory workers, environment and population. Biosafety practice in any clinical laboratory refers to proper use of equipment, devices and facilities,

in the way of assuring the safe storage, handling, and disposal of hazards biological material and living organisms capable of causing diseases. It also refers to reduce or eliminate accidental exposure to potential hazardous ^[3]. On the other hand, biosecurity is a critical part that has been put in place by bioscience laboratories efforts to prevent the spread or introduction of harmful organisms and toxins to human, animal community and plant life in the surrounding areas.

Laboratory staffs who deal with blood or any biological samples are usually at a continuous risk of getting occupational infections. Examples are numerous; the first surveys of serious laboratory associated infection were reported in 1949 by Sulk and Pike ^[4]. Since then, it has become essential to raise the awareness towards

biosafety and biosecurity principles to reduce any probable exposures of the laboratory workers, population and environment to potentially infectious agents [5]. Therefore, the present study was carried out to assess and evaluate the situation of biosafety and biosecurity practices, regulations and techniques in a sample of public and private laboratories facilities located in Tripoli city, Libya. Also to eventually come up with set of recommendations on how to implement the biosafety and biosecurity procedures.

METHODOLOGY

The study was conducted in Tripoli city from November, 2016 to April, 2017. During which, a number of 10 public and 25 private diagnostic medical laboratories were selected randomly to be involved in this study. These laboratories were surveyed to assess the awareness of biosafety and biosecurity measures and determine the practices being performed by laboratory technicians during the routine work. The Pre-validated design questionnaire was used [6, 7, 8] to obtain the relevant information from the enlisted laboratories. The survey questionnaire was divided into several sections, every section was composed of a number of questions highlighted different aspects of biosafety and biosecurity practices, In addition, basic questions regarding personal protection equipment (PPE) (e.g, wearing of hand gloves and lab coats during the work in the laboratories, vaccination programmer), and questions about routine laboratory practices such as, unsafe work practices (e.g, eating or drinking in laboratories, methods of disinfection, specimen handing collection and processing) were also included in the questioner. Furthermore, the questionnaire comprises questions related to laboratory facilities such as availability of staff room , hand washing sink, emergency equipment such as, fire safety, prevention and essential biosafety equipment i.e., biosafety cabinet. Moreover, questions regarding procedures for disposal of hazardous wastes, for instance sharp wastes, chemical waste and liquid biological waste were also involved in the data collection tool. Besides, the survey questionnaire inquired about, services provided inside laboratory such as, international biohazard symbols and signs, accident records, training in biosafety and biosecurity and programs for medical surveillance. The survey is designed to take no more than 15 minutes

to complete. Besides that, the survey was translated into two languages; English and Arabic to encourage laboratory workers for participation. Completed questionnaires from all the visited laboratories were received on weekly basis and the data was qualitatively checked and analyzed using statistical software SPSS V.20. P-value < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

Results showed that 60% of the technicians had more than five years work experience, whereas the rest were with lesser experience .The biosafety and biosecurity practices in these laboratories were noted and evaluated. Regarding the use of personal protective equipment, both gloves and lab coats were routinely used by 64.8% of the workers, 27% used it occasionally, and 8.2% had never used these protective tools. Moreover, the survey results confirmed that 69% of the technicians were not vaccinated against infectious diseases, as compared to 30.6% who did.

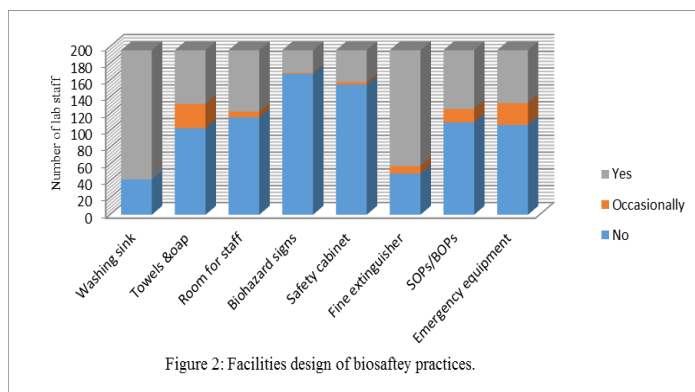
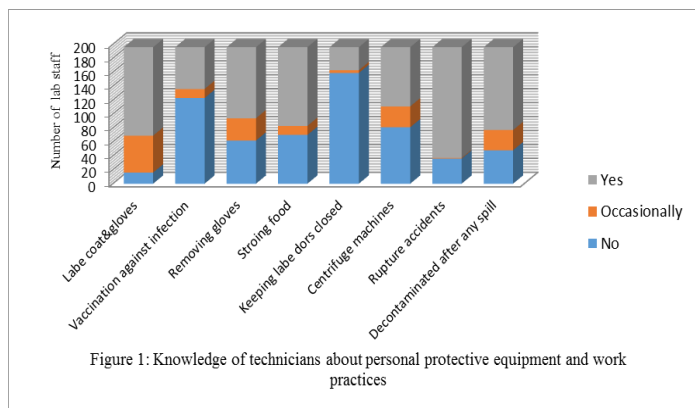
The study also assessed the practices of laboratory technicians during routine work in labs. It had been noted that, overall 52.0% of laboratory technicians take off their gloves when are using computer or phone, while 31.6% and 16.3 % never or occasionally did that. In addition, 57.5% of the respondents stored their food, drink, medicine and cosmetics in the labs. However, only 35.7% and 6.6% of the technicians never or rarely do that. Our results also revealed that 41.3% of the technicians did not cover centrifuge machines during centrifugation and accidents during specimen centrifuge were observed in 81% of all the laboratories surveyed. About 24.5% of the technicians declared that they do not disinfect worktables, while the remaining technicians sterilize their workbench either occasionally or regularly. The result also indicated that only 25.0% of the lab technicians had closed the lab doors during their experimentation. Knowledge of technicians about personal protective equipment and work practices are given in (Table 1& Figure 1). Although sink for hand washing was found in most of the labs, 78.6%, the availability of towels and soap was very low 32.7%. In addition, 39.8% of lab technicians said that there is not enough spaces between benches, cabinet, and equipment for cleaning, whereas 41.3 % said the opposite. Slightly over half 59.2% claimed that there are no separate place

for eating and drinking in their labs while 37.2% had it. Furthermore, 85.7 % reported that there are no proper biohazard signs posted on all entrance doors in the work area. Only 35.7% of laboratories had a written standard basic operating procedures (SOPs) however, the remaining 56% of labs throughout Tripoli are operated without a written standard operating procedures. Moreover, the essential equipment's which are so important to safe work area such as biosafety cabinets were not available in a many visited labs 79.1 %. Fire extinguishers were seen in 70.4 % of labs otherwise, very few number of lab staff 32.1% know the location of emergency equipment. (Table 1 & Figure 2) illustrates facilities design to biosafety practices. As demonstrated in Table 2 & Figure 3, over half 59.2% of the lab technicians reported that the waste containers are not in a good condition. Moreover, 77.6% of participants claimed that wastes are not properly segregated, similarly 77.6% of the technicians said there are no separate bins for sharps, so they throw these in regular waste bins. Procedures for disposal of liquid biological waste were not observed in 82.1% of laboratories. Besides that appropriate chemical waste containers were not available in 46% of the labs and around 56.1% of the lab staff did not use appropriate methods (i.e., autoclaving, chemical) to decontaminate all the biological cultures, stocks, and other regulated wastes before the disposal of them. Furthermore, the result indicates that majority 80.1% of diagnostic laboratories throughout Tripoli did not have programs for a medical surveillance and the accident records were not maintained in 81.6% as well as the biosafety training programs had not been provided to 88.3% of technicians. (Table 2 & Figure 4).

Table 1: Biosafety

Personal protective equipment and work practices	Yes	No	P
Is protective clothing worn for example, lab coat, and gloves?	64.8%	8.2%	0.579
Have you take any recommended vaccines against infection diseases?	30.6%	62.8%	0.000
Do you take off the gloves when working on computer,	52.0%	31.6%	0.002

or using a phone?			
Are food, drink, medicine and cosmetics not stored or consumed in lab?	57.7%	35.7%	0.001
Do you cover centrifuge and samples during centrifugation?	43.4%	41.3%	0.001
Do you come across any rupture accidents during specimen centrifugation?	81.1%	18.4%	0.000
Are work surface and equipment decontaminated after any spill or splash?	60.7%	24.5%	0.000
Do you keep your laboratory doors closed, when testing is undergoing?	16.8%	81.1%	0.000
Facilities design to biosafety practices.	Yes	No	P
Do you have a sink for hand washing in each laboratory room?	78.8%	21.4%	0.000
If a hand sink is available are towels and soap present?	32.7%	52.6%	0.003
Are spaces between benches, cabinet, and equipment accessible for cleaning?	41.3%	39.8%	0.002
Is there any facility for eating, drinking and for rest provided outside the lab area?	37.2%	59.2%	0.002
Does the lab have proper biohazard signs posted on all entrance doors to the work area?	13.8%	85.7%	0.000
Dou you have SOPs/BOPs in your laboratory?	35.7%	56.1%	0.003
Are safety cabinet available in laboratory?	19.4%	79.1%	0.000
Are fire extinguisher available in laboratory?	70.4%	25.0%	0.000
Does lab staff know the location of emergency equipment's?	32.1%	54.6%	0.001



Is there a medical surveillance program in place?	16.8%	80.1%	0.000
Is your laboratory maintaining accident records?	13.3%	81.6%	0.000
Is there any formal biosafety training programs in your lab?	10.7%	88.3%	0.000

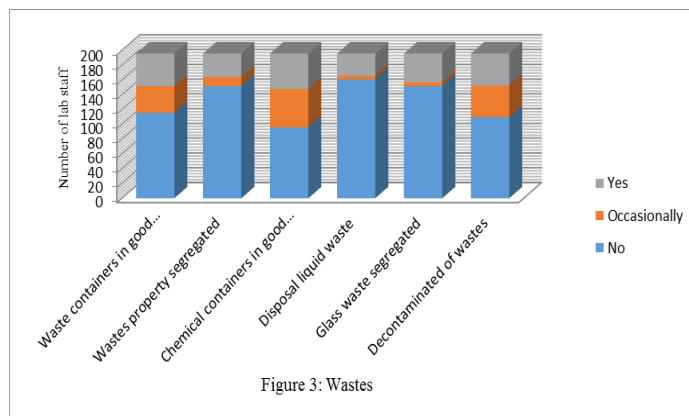
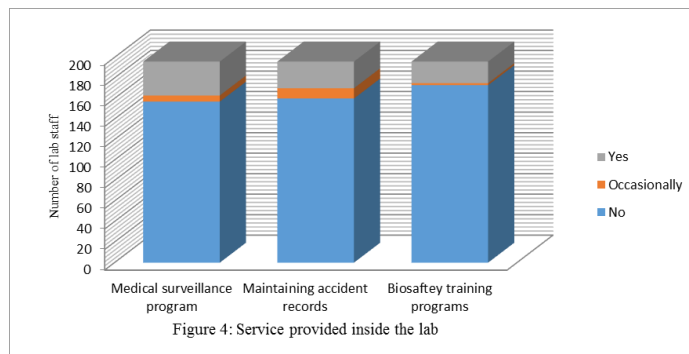


Table 2: Biosecurity			
Wastes	Yes	No	P
Are waste containers in a good condition?	22.4%	59.2%	0.000
Are wastes properly segregated?	16.3%	77.6%	0.000
Is broken glass / glass waste segregated from regular trash or other wastes?	19.9%	77.6%	0.000
Are there liquid biological waste disposal procedures in place?	15.3%	82.1%	0.000
Are chemical containers in a good condition?	24.5%	49.0%	0.000
Are all cultures, stocks, and other regulated wastes decontaminated before disposal by an approved decontamination method?	21.9%	56.1%	0.000
Services provided inside the lab	Yes	No	P



DISCUSSION

The current study observed that personal protective equipment (PPE) such as gloves and lab coats were the most consistently used in all labs. Both gloves and lab coats were used by 64.8% of the technicians and these findings differ from those reported from Pakistan, where they find that 31.9% of the participants used gloves and lab coats. The present study also indicated that the percentage of immunization service practice was low only 30.6% of the participants were vaccinated against infection diseases. This could be related with shortage of an adequate resource and the lack of the attention by the competent authorities. In this study, around 41.3% of the laboratory workers never closed the centrifuge machines during centrifugation. These

findings were differ from previously reported study conducted in Pakistan, where 25% of the technicians did not close the centrifuge machine while operating it ^[2]. Moreover, breakage of tubes in a centrifuge was very common in the present study, 81% and this can result in the disband of large amounts of aerosols, which may cause acquired infections. Overall 24.5% of the workers from all participated labs never disinfected their worktables. These findings are similar to those of an earlier study performed in Pakistan, where only 23.7% of technicians never disinfected their worktables. Moreover, a lack of the restriction to laboratory access was noted in this study, only small percentage 16% of respondents closed their laboratory doors during the work time and the remaining left their laboratory doors unlocked, which may lead to the transport of biological material infection outside the lab area. The current study observed that the desirable requirements for BSL-2 laboratories such as biosafety cabinets were not available in 77.1% of the laboratories. In contrast with a study conducted in Japan, where 70% of surveyed laboratories had biosafety cabinets ^[9]. Dedicated places to eat were also not available in 59.2% of laboratories compared to a Turkish study where only 38.3% of the technicians consumed drinks and food in the labs ^[10]. Besides, the present study revealed that soap for cleaning hands was not available in 52.6% of the laboratories and this may be one of the major causes of the laboratory acquired infections. Additionally, the international biohazard symbols and signs on door entrances were observed in 13.8% of the laboratories. However, this findings are differ from the observations of a study conducted in Nigeria where the use of the international biohazard symbols and signs were noted in only 3.8% of the laboratories ^[11]. According to this study around 56.1% of laboratories throughout Tripoli are operating without written standard operating procedures. Former investigations have been reported similar results and a nearly identical situations have been existed in developing countries such as Pakistan and Sudan ^[2, 4]. Our results indicated that 81.6% of laboratories did not have records of pervious spills, or injuries and accidents, Moreover, no formal biosafety training had been provided to 88.3% of the respondents and these findings were low when compared to a similar study in Turkey ^[10]. In this study, about 56.1%, of labs technicians did not practice the decontamination of all biological cultures, stocks, and other regulated wastes before

disposal. This finding is higher than the study conducted in Islamabad, Pakistan and Karachi, Pakistan which were 10.4% and 24.2% respectively ^[12,13].

The outcome of this study showed that 77.6% of laboratories did not have separate bins for sharps, This finding is incomparable with the study conducted by Thailand and Saudi Arabia which were 6% and 8% respectively ^[14,15]. In addition, the appropriate chemical waste containers and procedures for disposal of liquid biological waste were not observed in 46% and 82.1% respectively. Which means that respondents still throw sharps, chemical and liquid wastes in regular dustbin without using proper disposal measures. This is could be due to lack of the adherence towards waste management policy.

CONCLUSION AND RECOMMENDATIONS

The study indicates that the level of biosafety and biosecurity measures in all laboratories (public and private) surveyed were incredibly low. In addition, the awareness of laboratory personnel towards biosafety and the biosecurity principles implementation was also low. Based on the finding of this study, the following important points are recommended to improve the biosafety and biosecurity practice in the diagnostic laboratories:

Enhancing awareness level of the biosafety and the biosecurity practices for the current laboratories workers is required by all the possible means, be it through compulsory course works or seminars and conferences.

The ministry of health has an essential role in this issue by creating a specialized department in all the hospitals to design and follow up the occupational safety, focus on training staff, to promote the awareness and develop their skills. There is a great need to establish teaching the principles of biosafety and biosecurity in Universities and health care Institutions, at both graduate and postgraduate levels, in order to raise the awareness among technologists and technicians in all sectors.

This definitely will improve the level of the biosafety especially in hospitals and research laboratories.

All authors contributed equally in this manuscript

DISCLOSURE STATEMENT

Not declared.

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