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Assessment of Biosafety and associated Occupational Hazards among Laboratories Health Workers in Governmental Moderate and High Complexity Medical Labs (Jeddah, 2018)

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Abstract

Background: *Medical laboratories are one of the most common hazardous places for health care workers, where a wide range of occupational hazards can occur.To avoid these hazards, biosafety measures should be strictly implemented, which necessitates awareness of the health care workers about these measures and comply with the standard biosafety practices.*

Objectives: *This study aimed at the assessement ofthe knowledge level of health care workersregarding biosafety in medical labsand to estimate the prevalence and possible factors associated with occupational lab incidents among health care workersin main governmental laboratories (BLS2, BLS3) in Jeddah, Kingdom of Saudi Arabia.*

Subjects and Methods: *Through a cross sectional design, 171 medical laboratory professionals working in governmental medical laboratories in Jeddah were included in the study. Data were collected using a self-administered structured questionnaire reflecting their knowledge and adherence to biosafety measures as well as previous exposure to incidents while working in the labs.*

Main Results: *The mean age of the health care workers in the labs (n=171) accounted for 36.4±8.7, with a slight dominance of females (54.4%). Almost one half of them (53.8%) had experience in lab work for more than ten years. While great majority of the workers 152(88.9%) reported that they got information about OHS, tested the level of knowledge showed lesser percentage 102(59.6%) who had above average level of knowledge about standard precautions. Significant differences in the level of knowledge were detected among workers according to their job title, previous training and receiving biosafety manual; where the highest percentage of knowledgeable workers was recoded in consultants (85.7%), previously trained (65.2%) and who received biosafety manual (66.9%) $p<0.05$. Previous incidents were reported by one third (36.3%) of the workers; its significant predictor is the positive biosafety practice, as it was much less frequent among health workers who have above average level of positive biosafety practices than those with below level (60.9% vs 31.5%) with an odds ratio (OR=0.296; 95% CI:0.119-0.733).*

Conclusion and Recommendations: *Training on occupational health & safety are a significant predictor of knowledge, practice, and incidents of the health workers in the labs. This study shows that there is a great need to establish Health and Safety Program for Laboratory Safety Officer (LSO), as well as the need to organize a National training programs to increase awareness of the Laboratories health workers about proper laboratory techniques and self-hygienic principles.*

Keywords: *Biosafety, Occupational hazards, laboratories Health workers.*

Introduction

Medical laboratories incorporate variety of occupational risks to Labratories Health Workers, as they continuously handle harmful biological agents and considered at higher risk of biological laboratory-associated infection.[1] Several published reports provided evidences for the threat of the laboratory-associated infections of emerging and re-emerging diseases on the health workers.[2] Therefore, laboratory acquired infections have become a primary concern all over the world since an early twentieth century.[3]It is essential for Laboratories Health Workers who work with biohazards agents to be familiar with standard practice and training to a level of competence that ensures their safety as well as the community.[4] In this respect, the WHO use a four-level Risk Group system to classify microorganisms (bacteria, fungi, and viruses). Risk Group 1(Low Risk) is for the safest organisms, and Risk Group 4 (Extreme Risk), and recommended regulation and execution of biosafety measures for clinical laboratories.[5] The different biosafety levels include typical biological agents used, safe work practices, specialized safety equipment (primary barriers) and facility design (secondary barriers).[6]The control of biological hazards use a hierarchy of control measures, categorized as administrative controls, engineering controls and personal protection.[7]

Healthcare workers in general, and workers in labs in specific, are potentially exposed to an increased risk of acquiring wide range of infectious diseases including human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV), in addition to outbreaks of epidemics of diseases such as Ebola and Lassa fever which often have a fatal outcome; therefore, adherence to standard precautions is essential for all laboratory workers.[8]

Several studies were done in Saudi Arabia,[9] India,[10] Ghana,[11] Ethiopia,[12]Pakistan,[13] and Yemen[14] concluded fair to poor biosafety knowledge and practices among laboratory employee as well as lack of awareness regarding biosafety practices. Moreover, in another study conducted in one Clinical Laboratory in Shaqra University (Saudi Arabia) revealed that the workers in Laboratories need to improve their knowledge, it is theier responsibility for the adherence to biosafety policy, to use biosafety manual, personal protective equipment, biosafety containment level, and protection in their daily laboratory work.[15]

The main goal in this study to assess the level of Biosafety knowledge and to estimate the prevalence of hazardous events involving potentially infectious biological material among laboratories employee in medical diagnostic laboratories (BLS2, BLS3) at Jeddah in 2018. The results of this research would be utilized as a base for future plans to enhance the biosafety culture in the Ministry of Health laboratories Environments.

Subjects and Methods

Through a cross-sectional study design, all laboratory health care workers in the Ministry of Health Laboratories in Jeddah hospitals (King Abdul Aziz Hospital, Althagher Hospital, East Jeddah Hospital, King Abdullah Medical Complex, King Fahad Hospital, Jeddah Regional Laboratory and Poisons Center laboratories) were considered to be eligible for inclusion in the study (n=574). Exclusion criteria stipulated staff who were not involved in processing laboratory samples, such as administrative staff. The samplesize was calculated for an α of 0.05 and power $(1 - \beta)$ of 0.80, 95% CI, and using the formula: $n = (z)\ 2\ p\ (\ 1 - p\ )\ /\ d2$ (the sample was accounted for (171) who were enrolled by convenience sampling. A semi-structured questionnaire was constructed to collect relevant data. The questionnaire was prepared from previous studies which examined knowledge about occupational safety, training, and incidence of occupation hazards. The questionnaire is divided into 3 parts. Part 1: included information on sociodemographic characteristics of participants and information on the biosafety

manual and training. Part 2: Knowledge about standard precaution with following sections (Sources of information, Basic standard precaution background, Associated factors affecting knowledge level), In total, 171 Laboratories Health Workers were given a questionnaire, including eight multiple choice questions to reflecting their knowledge about basic Slandered Precaution background ; its overall mean score percentage was used for further classification, with a cut off level of 60% or above as "above average level of knowledge". Part 3: Recording & reporting of laboratory incident and hazards among Laboratories Health worker**.** SPSS ver.20 was used for data entry and statistical analysis. Chi square test was used for comparing differences in the frequency of categorical variables, and a p value <0.05 was considered as an indication of significance. Ethical issues were ensured, and approval was collected from the Ethics' Committee, Directorate of Health Affairs, Jeddah, Saudi Arabia.

Results

Out of all enrolled health workers (n=171), females constituted (54.4%), the mean age accounted for 36.4±8.7 years, with almost one quarter (24%) aged less than 30 years and only 9.9% aged 50 years or older. More than one half of the workers had Bachelor degree, and 11.7% have Ph.D. degree. Specialists formed one half (49.7%) of the workers, while consultants constituted 8.2%, and more than one half of the workers (53.8%) had experience in lab work for more than ten years [Table 1].The great majority of workers (88.9%) reported that they have information about standard precaution, and only (11.1%) denoted that they had never heard about it. The most frequent sources of information included training courses (82.9%) followed by academic teaching (65.8%), while the least common sources were the mass media (15.8%) and friends (15.8%) [Table2]. The majority of the health workers (81.2%) reported that they had received biosafety training and lesser percentage (74.7%) reported that they had received a biosafety manual [Figure1] and [Figure 2].

The mean score for the eight MCQs accounted for 62.4%±24.7% and using the cut off level of >60% as above average level, [Figure 3] displays that only (59.6%) of the health workers had above average level of knowledge. Regarding factors possibly associated with changes in the level of knowledge, [Table3] demonstrates that job title, previous training and receiving Bio-Safety manual were significant predictors. The highest percentage of knowledgeable workers was observed in consultants (85.7%), those who had previous training (65.2%) and those who received biosafety manual (66.9%) p<0.05. No statistically significant difference was observed for association with gender, age nor years of experience.

One third of the Laboratories Health workers (36.3%) had been exposed to previous incidents while working in the labs, out of them there were 9 (14.5%) who said that they did not report the infection control about these incidents [Figure 4]. The incidents were significantly much less frequent among health workers who have above average level of positive biosafety practices than those with below level (60.9% vs. 31.5%) with an odds ratio (OR=0.296; 95% CI:0.119-0.733), otherwise there was no statistically significant difference in the frequency of incidents according to gender, job title, years of experience nor knowledge level [Table4].

Approximately, 49% reported that they always recap the needle after use, whereas 15% reported doing that most of the times. Occupational infection, needle stick injury and recapping needles after use was associated with lack of training on biosafety (P<0.05).

Table1: Demographic characteristics of the health workers in the labs (n=171).

Characteristics	No.	Percentage
Gender:		
Male	78	45.6
Female	93	54.4
Age categories:		
<30 years	41	24.0
30-<40 years	75	43.9
40-<50 years	38	22.2
50+ years	17	9.9
Qualifications:		
Diploma	22	12.9
Bachelor	93	54.4
Higher diploma	36	21.1
PhD	20	11.7
Job Title:		
Consultant	14	8.2
Specialist	85	49.7
Technician	56	32.7
Trainee	16	9.4
Years of experience:		
<10 years	79	46.2
10-<20 years	63	36.8
20+ years	29	17.0

Table 2: Sources of information about standard precautions (n=171).

Characteristics	No.	Percentage
Got information about occupational health and standard precautions:		
Yes	152	88.9
No	19	11.1
Sources of information (n=152):		
Training course	126	82.9
Academic	100	65.8
Internet	67	44.1
Program	64	42.1
Books or journal	47	30.9
Mass media	24	15.8
Friends	24	15.8

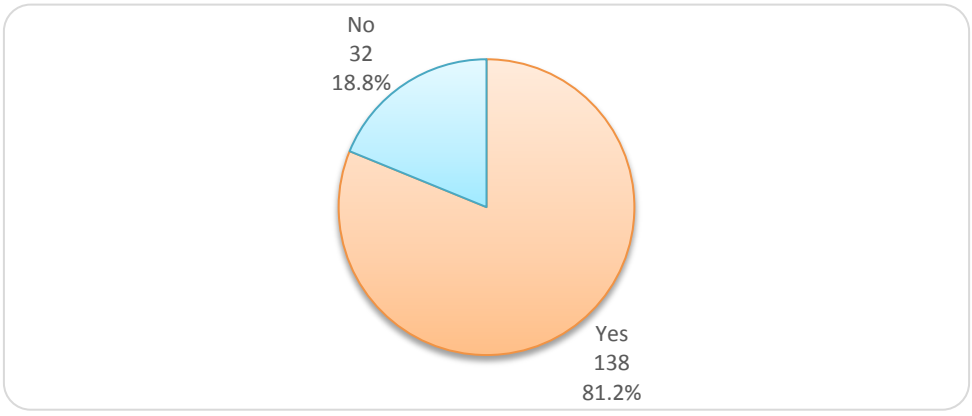

Figure 1: Percentage of health workers who ever received any biosafety training.

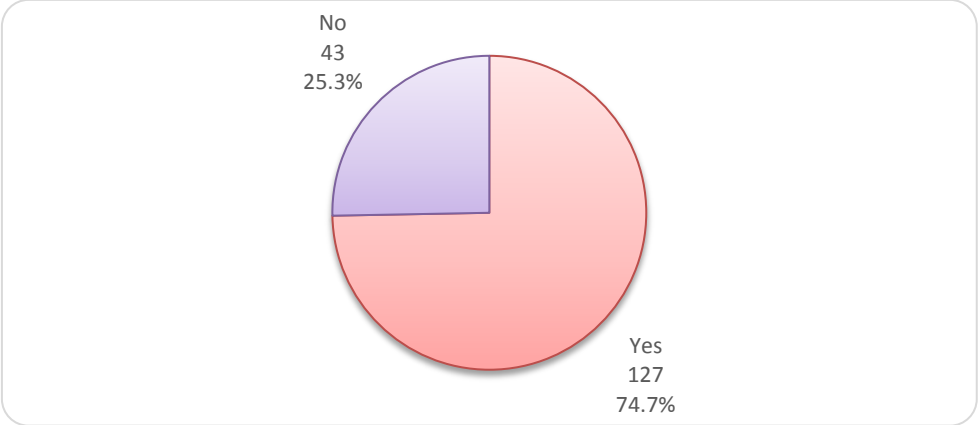

Figure 2: Percentage of health workers who ever received any biosafety manual

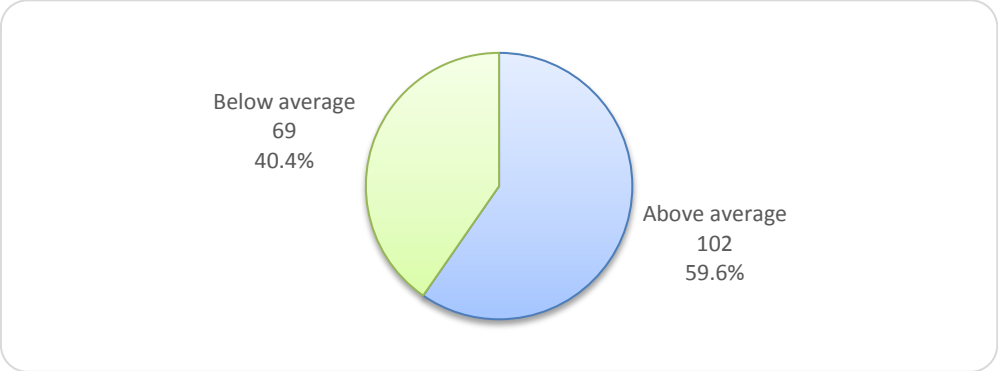

Figure 3: Level of knowledge of the health workers about basic background of standard precautions in the lab.

Table 3: Differences in the level of knowledge of the health workers about basic standard precautions according to their characteristics

Characteristics	Level of knowledge				X^2	P*
	Above average		Below average			
	No	%	No	%		
Gender:						
Male	46	59.0%	32	41.0%		
Female	56	60.2%	37	39.8%	0.027	0.869
Age categories:						
<30 years	23	56.1%	18	43.9%		
30-<40 years	42	56.0%	33	44.0%		
40-<50 years	25	65.8%	13	34.2%	2.070	0.558
50+ years	12	70.6%	5	29.4%		
Job title:						
Consultant	12	85.7%	2	14.3%		
Specialist	54	63.5%	31	36.5%		
Technician	26	46.4%	30	53.6%	8.604	0.035**
Trainee	10	62.5%	6	37.5%		
Years of experience:						
<10 years	48	60.8%	31	39.2%		
10-<20 years	36	57.1%	27	42.9%	0.275	0.871
20+ years	18	62.1%	11	37.9%		
Previous training:						
Yes	90	65.2%	48	34.8%		
No	12	37.5%	20	62.5%	8.315	0.004**
Received biosafety manual:						
Yes	85	66.9%	42	33.1%		
No	17	39.5%	26	60.5%	10.045	0.002**

*Based on Chi Square **Statistically significant

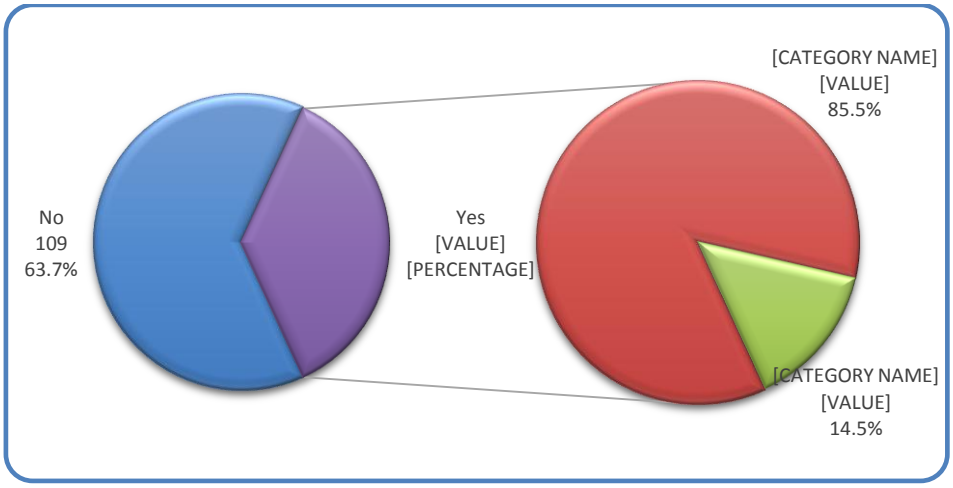

Figure 4: Self-reported incidents in the labs and reporting to the infection control about the incident

Table 4: Differences in exposure to previous incidents in the labs according to characteristics of the health workers

Characteristics	Previous exposure to incidents				X^2	P*
	Yes		No			
	No	%	No	%		
Gender:						
Male	27	35.1%	50	64.9%		
Female	33	35.9%	59	64.1%	0.012	0.913
Job title:						
Consultant	2	14.3%	12	85.7%		
Specialist	30	35.7%	54	64.3%		
Technician	25	45.5%	30	54.5%	7.094	0.069
Trainee	3	18.8%	13	81.3%		
Years of experience:						
<10 years	29	37.7%	48	62.3%		
10-<20 years	25	39.7%	38	60.3%	3.416	0.181
20+ years	6	20.7%	23	79.3%		
Knowledge level:						
Above average	34	33.3%	68	66.7%		
Below average	26	38.8%	41	61.2%	0.529	0.467
Positive biosafety practice:						
Above average	46	31.5%	100	68.5%		
Below average	14	60.9%	9	39.1%	7.481	0.006**

*Based on Chi Square **Statistically significant

Discussion and Conclusion

Medical laboratories are potentially hazardous work places, workers in labs are exposed to a wide range of biologic hazards as well as physical incidents. There is general agreement about adequate preparedness of the workers in terms of training to improve their knowledge and skills in addition to providing them with proper personal protective equipment, and almost all measures and guidelines are listed in manuals which are distributed to workers in labs, but the adherence to these measures, and acquired knowledge about biosafety, as another issue, which needs to be investigated, especially that faulty practices could lead to serious health problems. Therefore, the current study aimed at assessment of the level knowledge of workers in labs about biosafety and evaluating the frequency of incidents among them.

Although the great majority of the workers (88.9%) reported that they got information about occupational health and standard precautions, which agree with findings in other studies in Ethiopia[12] and Nigeria,[16], a much lower percentage of them (59.6%) who could achieve above average score in the MCQs, which indicate substantial knowledge gap about biosafety among workers in labs in Jeddah Saudi Arabia. These wide-ranging results propose that the perceived knowledge did not reflect the actual knowledge, thus suggesting that the participating workers could have misperceptions about their knowledge.

As expected, knowledge level was affected mainly by previous training, which comes in line with previous similar researches' findings, [11][12][14][15][17] and emphasizes the importance of training when planning for improving the knowledge of professionals working labs. Also, receiving biosafety manual, was another factor identified in the current study to be directly associated with higher level of knowledge of the recipients, this conclusion was indirectly withdrawn in Ethiopia[12] and Yemen[14] where they partly attributed the lack of knowledge of the lab workers to the shortage of manuals distributed to the majority of health workers. These findings assert the efficacy of the biosafety manual prepared for lab workers.

Consultants were found to have a superior level of knowledge (85.7%) and lowest rate of reported incidents (14.3%), which typically describes their profession, as they are mostly dedicated to providing consultations and rarely involved in routine manual activities. Similar findings were reported in Ghana.[11]

Regarding incidents. more than one third of the health care workers in the labs (36.3%) indicated that they had been exposed previously to incidents, which is higher than what was reported in a study conducted in other cities in Saudi Arabia, such as Riyadh, where 22% of the workers in pathology labs were exposed to either needle stick or splash of fluids in the face,[9] in Al-Madinah where 33% of the recruited health workers from governmental and private hospitals experienced occupational infection, while 24% experienced needle stick injury.[17] Much higher percentages were recorded in health workers in labs of educational hospitals in Iran, where 94 (43.5%) of participants experienced needle stick injury and 70 (36.3%) had splash injury during their work life.[18] These reported frequencies to give an idea about the magnitude of occupational hazards to which the lab workers are exposed, as one of every three workers carry the risk of experiencing incidents along his work in the lab.

Perhaps the best protective and preventive measures of lab incidents is the proper biosafety practice, our study showed that among other tested variables, the only factor which showed significant difference in occurrence of lab incidents is adopting positive biosafety practices where the odds ratio (OR=0.296; 95% CI:0.119-0.733), which indicates that positive biosafety practice in labs cut down the possibility of acquiring incidents to almost one third to one fourth. To achieving best practice, The Laboratories Health workers need to be empowered by adequate training to improve their knowledge and skills, provide them with clear instructions and manuals, in addition to availing all personal protective equipment and ensuring safe work environment.[12][13][15][18][19]

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References

1. Sewell DL. Laboratory-associated infections and biosafety. Clin Microbiol Rev [Internet]. 1995 Jul 1 [cited 2016 Oct 13];8(3):389–405. Available from: http://cmr.asm.org/content/8/3/389.abstract
2. Fauci AS. Emerging and reemerging infectious diseases: the perpetual challenge. Acad Med. 2005;80(12):1079–85.

3. Coelho AC, D\'\iez JG. Biological risks and laboratory-acquired infections: a reality that cannot be ignored in health biotechnology. Front Bioeng Biotechnol. 2015;3.
4. UNAIDs Unic, Organization WH. Global HIV/AIDS response: epidemic update and health sector progress towards universal access: progress report 2011. Glob HIV/AIDS response epidemic Updat Heal Sect Prog Towar Univers access Prog Rep 2011. 2011;
5. WHO. World Health Organization. Biorisk management: Laboratory biosecurity guidance. Geneva [Internet]. 2006; (September):1–41. Available from: http://www.who.int/csr/resources/publications/biosafety/WHO_CDS_EPR_2006_6.pdf
6. US Department of Health and Human Services. Biosafety in Microbiological and Biomedical Laboratories. Public Heal Serv [Internet]. 1999;5th Editio(April):1–250. Available from: http://www.cdc.gov/biosafety/publications/bmbl5/index.htm
7. Fadeyi A, Fowotade A, Abiodun MO, Jimoh AK, Nwabuisi C, Desalu OO. Awareness and practice of safety precautions among healthcare workers in the laboratories of two public health facilities in Nigeria. Niger Postgrad Med J [Internet]. 2011;18(2):141–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21670783
8. Driscoll T, Takala J, Steenland K, Corvalan C, Fingerhut M. Review of estimates of the global burden of injury and illness due to occupational exposures. Am J Ind Med. 2005;48(6):491–502.
9. Javed Akhter Sameera Al Johani, MD, Loulwah Hammad, BSc, Khalid Al Zahrani, MSc P. Laboratory Work Practices and Occupational Hazards among Laboratory Health Care Workers: A Health and Safety Survey. J Pharm Biomed Sci. 2011;04(04):9.
10. Shekhar H, Patel M, Jain C, Garg N, Mangukiya K. Awareness to health hazards and biosafety precautions among laboratory technicians working in a tertiary-care center in Rajasthan, India. Int J Med Sci Public Heal [Internet]. 2015;4(1):15–8.
11. Akagbo SE, Nortey P, Ackumey MM. Knowledge of standard precautions and barriers to compliance among healthcare workers in the Lower Manya Krobo District, Ghana. BMC Res Notes. 2017;10(1):432.
12. Kassa W. Assessment of Knowledge, Attitude and Practice towards Occupational Health and Safety among Medical Laboratory Personnel in selected Governmental Teaching Hospitals of Ethiopia. 2015;
13. Nasim S, Shahid A, Ayaz Mustufa M, Arain GM, Ali G, Taseer I ul H et al. Biosafety perspective of clinical laboratory workers: A profile of Pakistan. J Infect Dev Ctries. 2012;6(8):611–9.
14. Al-Abhar N, Al-Gunaid E, Moghram G, Al-Hababi AA, Al Serouri A, Khader YS. Knowledge and Practice of Biosafety Among Laboratory Staff Working in Clinical Laboratories in Yemen. Appl Biosaf. 2017;1535676017733451.
15. Cruz CP, Cruz JP, Abu Bakr SA, Thazha SK. Biosafety knowledge and perceptions of clinical laboratory science educators in Shaqra University. J Infect Public Health [Internet]. 2015;8(4):398. Available from: http://linkinghub.elsevier.com/retrieve/pii/S1876034115000568
16. Nasim S, Shahid A, Mustufa MA, Kazmi SU, Siddiqui R, Mohiuddin S, et al. Practices and Awareness Regarding Biosafety Measures Among Laboratory Technicians Working in Clinical Laboratories in. 2010;172–9.
17. Khabour OF, Ali KH Al, Mahallawi WH. Occupational infection and needle stick injury among clinical laboratory workers in Al-Madinah city , Saudi Arabia. 2018;1–7.
18. Ebrahimi MH, Mirrezaie SM, Aghayan SS, Mehrdad R, Pouryaghoub G,

Yarmohammadi M, et al. Occupational exposure to blood and other bodily fluids among laboratory technicians: An underestimated risk factor. Int J Heal Stud. 2015;1(1):page-24.

19. Main CL, Carusone SC, Davis K, Loeb M. Compliance with personal precautions against exposure to bloodborne pathogens among laboratory workers: a Canadian survey . Infect Control Hosp Epidemiol. 2008;29(1):66–8.