Migration Letters

Volume: 19, No: S5 (2022), pp. 531-541

ISSN: 1741-8984 (Print) ISSN: 1741-8992 (Online)

www.migrationletters.com

Knowledge and Practice of Postgraduate Laboratory Technician Students About Occupational Hazards and Safety Measures

Nada Hashim Fagira[1], Wejdan Hassan Alamoudi[2], Abubakr Mohammed Mohammed Suhail[3], Fatimah Mohammed Mohammed Suhail[4], Hussain Bakry Koriri[5], Nasser Abduh Ahmad Juraiby[6], Fatimah Ahmad Yahya Mokly[7], Ibrahim Ali Sumaili[8]

Abstract

Introduction: laboratory workers face several occupational health hazards at work. A laboratory hazard could cause damage or injury. Aim of Work: To assess the level of occupational safety measures and knowledge about occupational hazards among laboratory technicians' students and factors affecting their knowledge and safety practice. Materials and Methods: This is a descriptive cross-sectional study among 178 postgraduate laboratory technicians' students from Makkah hospitals, Saudi Arabia. Data were collected by a self-administered validated structured questionnaire based on previous studies. Results: Less than 50% of the studied technicians had good knowledge (47.2%), about safety measures including general administrative measures, personal protection, standard procedures and lab work area (77%, 71.3%, 59%, 72.5%; respectively). The most frequently reported occupational hazards are chemical hazards (55.6%) followed by ergonomic hazards (19.7%) and biological hazards (14%). Age and education are significant independent predictors of good occupational health knowledge. Moreover, knowledge, education and duration of employment are significant independent predicators for good safety practice. Conclusion and Recommendations: Knowledge of occupational health hazards and safety measures among laboratory technicians are not adequate. This can be improved through the organization of regular laboratory safety training. Developing national regulations for occupational lab health and safety is necessary.

Keywords: *Laboratory technician, Occupational hazards, Safety measures and Knowledge.*

Introduction

Employees in hospitals and health-care institutions are exposed to many risks, particularly,

[1] Laboratory specialist, King Abdullah medical complex Jeddah, Saudi Arabia
[2] Laboratory specialist, King Abdullah medical complex Jeddah, Saudi Arabia
[3] Technician nursing, Farasan general hospital, Saudi Arabia.
[4] Technician nursing, Farasan general hospital, Saudi Arabia.
[5] Laboratory technician, Southern sector of primary care jazan, Saudi Arabia.
[6] Laboratory technician, Juraibah praimary health care center, Saudi Arabia.
[7] Lab specialist, sabya hospital, Saudi Arabia.
[8] Laboratory technician, Jazan health, Saudi Arabia.

those dealing withclinical specimens, can be highly exposed to contamination and infection. Blood, tissue, or body fluid samples, along with medical waste, are potentialbiologic hazards and are considered to be the most significant foci of infectionsamong laboratory employees (Kaplan and Emin, 2018). In addition to infection, chemicals, gases and solventsmay be explosive, inflammable or toxicand this may cause fires, gassings and explosion in laboratory if not cautiouslyhandled (Nisii et al., 2009). Other non- infectious hazards such as cuts, skin injuries, electrical shock, and burns dueto corrosives are also common (Tohda,2016).

Laboratory hazards are classified as biologic, chemical, physical, electric/ mechanical or psychological (Akagbo et al., 2017). The exposure to occupational hazards arises mainly because of theway the laboratory staff handle theirwork and the precautions followed in their work environment (Sewunet et al., 2014). It was reported that about 66% of laboratory staff were exposed to at least one type of biologic hazard, often being bacteria and parasites (Tait et al., 2018). In addition, risk of exposure increases due to inadequate and poor safety arrangements in the laboratory and absence of biosafety cabinets, safety manuals and safety kits.Another crucial factor is knowledge and awareness regarding occupational hazards in the laboratory and how to deal with in case of accidents (Shekharet al., 2015).

The lack of awareness about safetymatters is associated with poor handlingand unsafe practices during collection, processing, and discarding of samples, potentially leading to enhanced exposure to microorganisms (Shafiq et al., 2019).

Occupational safety and preventivemeasures strengthen and sustain the physical, mental, and social well-beingof workers across all occupationalcategories (Reda et al., 2021). A quasi-experimental previous study in our locality revealed that lab techniciansworking in teaching lab had poorknowledge and practices of safetymeasures that were improved afterintervention (El-Gilany et al., 2017).So, it is required to assess hospital laboratory staff's knowledge, attitudes, and practices regarding the likelihood to be exposed to workplace accidents (Senthil et al., 2015).

Aim of Work

To evaluate the knowledge level of occupational hazards and safety practice among postgraduate laboratorytechnicians and factors affecting their knowledge and safety practice.

Materials and Methods

Study design: A descriptive cross-sectional study.

Place and duration of study: Thisstudy was performed at the Makkah hospitals, Saudi Arabia, during the period from February 2022 to July 2022.

Study subjects: allpostgraduate laboratory technician students were chosen during this year were involved.

Sample size: All registeredpostgraduate laboratory technician students (n=210). One hundred eighty-seven out of 210 (84.8%) were regular attendants and completed thequestionnaires.

Study methods: An Arabicself-administered semi-structured questionnaire included three sections:

I- Demographic and occupationaldata (age, gender, education , marital status workplace: university hospital or ministry of health (MOH) hospital, duration of work, current private lab work, history of Hepatitis B virus vaccine, type and severity of occupational health hazards) .

II- Data about Knowledge ofoccupational hazards, pattern ofexposure, and preventive measures (8 items: 1. I have information about occupational health, 2. I am aware of the occupational hazards at work,

3.I know how to avoid occupationalhazards, 4. I know about preventive measures to be taken at work, 5. I knowwhat hazards I am being exposed to, 6. Iknow how I may be affected, 7. I knowwhat I have to do to keep myself and others safe, 8.I know how to check andspot when something goes wrong, and to whom I will report any problems) (Alqam, 2013)

Questions related to thePractice of safety measures of the employees. Safety measures are adaptedfrom OSHA guidelines for occupationalhealth and safety (8 items: (OSHA, 2011). Safety measures are divided to 4 domains; general administrativemeasures (1 item: Access to the laboratory to authorized personnel only), personal protection (7 items: 1. Lab coveralls, gowns worn all the time during lab work, 2. Wear appropriate gloves when required, 3. Wash theirhands after handling infectious materialor before leaving lab work, 4. Safety glasses or face shields to protect from splash, 5.Wear mask, 6. Wear special shoes, 7. Eating, drinking and smokingare prohibited in lab work areas),standard procedures (3 items: 1. Mouthpipetting is prohibited, 2. Doing all processes with least fumes or splashes or aerosol and 3. Incident reporting for splash/ spills injuries to lab supervisor),lab work area (5 items: 1.The lab shouldbe kept neat clean free of the material not pertinent to work, 2.Work surfaces must be decontaminated after spill and atend of working day, 3. All contaminatedmaterials, specimen, bacterial cultures are disinfected in autoclaves before disposal or cleaning for reuse, 4.Sharp containers used and disposed ofproperly and 5.The disinfectant used is appropriate and its efficacy ensured). Each item is evaluated using Likert scale ranging from strongly disagree to strongly agree (1 to 5). The cutoff pointfor adequate levels was set at 4 for all assertions in each domain. The cutoff for knowledge of occupational hazards was 32.

General administrative measures, personal protection, standard operatingprocedures, and lab work area all had cutoff points of 4, 28, 12, and 20; respectively. The projected cutoffpoints were determined by adding the agree and strongly agree responses to all items and assigning a good score.

Ethical Approval

The protocol was approved fromthe research ethical committee.

Consent

Verbal consent was taken from all the studied subjects.The participation was voluntary, and all participants received guarantees about the privacy and anonymity of the data.

Data Management

Data were analyzed using by SocialPackage for Science Statistical Programv 22 (SPSS Incl., Chicago, IL, US).Quantitative variables were described in means and SDs as well as medians and minimum to maximum. Qualitativevariables were described in numbers andpercent. Chi-squared test was utilized for categorical variables. Binary forward wald logistic regression analysis was utilized to determine the independent predictors of knowledge and practice as the dichotomous outcome variable. Variable with statistical significance in bivariate analysis were entered into the logistic regression analysis. Adjusted odds ratios and their 95% CIs underwent calculation. A p value $\leq 0.05$was statistically significant.

Results:

The mean score for occupational health knowledge was 30.8. Less than half of studied lab technicians have good knowledge (47.2%). The mean (SD) score for general measures, personal protection, standard procedures and safe lab work area are 4.06 (0.7%), 29.7 (3.6%), 12.2 (2.09%), 21.02(2.4%); respectively). Most of them have high levels for safety measures including general administrative measures, personal protection, standard procedures and lab work area (77%, 71.3%, 59%, and 72.5%; respectively) (Table 1).

The mean age of studied group is 35.7 and near half of them (48.9%) are males. About two thirds (62.9%) received Hepatitis B vaccine. Most of them (80.3%) are diploma holders and work in university hospitals (79.2%). About two thirds of them have worked for less than 15 years (58.4%) (Results are not tabulated).

	Average scores Mean (SD) Min-max	Levels	
		Good No (%)	Bad No (%)
Knowledge of occupational hazards (8 items)	30.8 (6.4) 16-40	84 (47.2)	94 (52.8)
Safety measures			
General administrative measures (1 item)	4.06 (0.7) 2-5	137 (77)	23))41
Personal protection (7 items)	29.7 (3.6) 21-35	127(71.3)	51(28.7)
Standard procedures (3 items)	12.2 (2.09) 6-15	105 (59)	73(41)
Lab work area (5 items)	21.02 (2.4) 15-25	129 (72.5)	49(27.5)

There was a statistically significant difference in occupational health knowledge according to age, gender, education and employment duration ($p<0.05$). The higher knowledge scores were present among the older age group (≥35 years), males, specialty trained workers and senior workers. In addition, older age group (≥ 35 years); AOR (95%CI): 3.8 (1.9-7.7) and better education in the form of specialty training AOR (95%CI): 5.9(2.06-17.02) showed increased chance of good knowledge (Table 2)

	Total	Knowledge score	Test of significance $\chi 2$	Adjusted OR (95%CI)
		Good (≥32) No (%)		
Overall	No =178#	No =84 (47.2%)##		
Age				

≤35 (r) >35	105(59) 73 (41)	32 (30.5) 52(71.2)	28.7 p<0.001*	3.8 (1.9- 7.7)
Gender Male Female (r)	 87(48.9) 91(51.1)	 54(62.1) 30(33)	 15.1 p<0.001*	 -----
Education Diploma (r) Specialty training	 143(80.3) 35 (19.7	 54(37.8) 30(85.7)	 25.9 p<0.001*	 5.9 (2.06- 17.02)
Type of hospital MOH (r) University hospital	 141(79.2) 37(20.8)	 64(45.4) 20(54.1)	 0.8 p=0.3	 -----
Duration of employment <15 years (r) ≥ 15 years	 104(58.4) 74(41.6)	 32(30.8) 52(70.3)	 27.07 p<0.001*	 ------

As regards factors associated with good safety practice, there are significant difference in the general measures according to age and knowledge state (p<0.05). Lab work areas, work procedures and personal protection are significantly different according to age, education, duration of employment and knowledge state (p<0.05)(Table3) .

	Total	General measures	Lab work area	Work Procedures	Personal protection
	No (%)	Good (≥4) No (%)	Good (≥20) No (%)	Good (≥12) No (%)	Good (≥28) No (%)
Overall	No=178#	137 (76.9%)	129(72.4%)	105(58.9%)	127(71.3%)
Age <35 (r) ≥35	 105(59) 73 (41)	 74(70.5) 63(86.3)	 68(64.8) 61(83.6)	 48(45.7) 57(78.1)	 62(59) 65(89)
Test of sig		p=0.01*	p=0.006*	p<0.001*	p<0.001*
Sex Male Female	 87(48.9) 91(51.1)	 72(82.8) 65(71.4)	 64(73.6) 65(71.4)	 65(74.7) 40(44.0)	 71(81.6) 56(61.5)
Test of sig		p=0.07	p=0.7	p<0.001*	p=0.003
Education					

Diploma (r)	143(80.3)	31(88.6)	33(94.3)	30(85.7)	34(97.1)
Specialty training	35 (19.7)	106(74.1)	96(67.1)	75(52.4)	93(65.0)
p value		p=0.06	p=0.001*	p<0.001*	p<0.001*
Type of hospital					
MOH	141(79.2)	105(74.)	100(70.9)	76(53.9	98(69.5)
University hospital	37(20.8)	32(86.5)	29(78.4)	29(78.4)	29(78.4)
p value		p=0.1	p=0.3	p=0.007*	p=0.2
Duration of employment					
<15 years (r)	58.4))104	73(70.2)	68(65.4)	47(45.2)	61(58.7)
≥ 15 years	74(41.6)	64(86.5)	61(82.4)	58(78.4)	66(89.2)
p value		p=0.01*	p=0.01*	p<0.001*	p<0.001*
T.Knowledge score	94 (52.8)	61(64.9)	55(58.5)	36(38.3)	53(56.4)
Bad (r)	84 (47.2)	76(90.9)	74(88.1)	69(82.1)	74(88.1)
Good					
p value	χ^2=16.4	p<0.001*	p<0.001*	p<0.001*	p<0.001*

According to logistic regression analysis, good knowledge (≥32) increases thechance for good safety practice across all domains, general measures, lab work areas, work procedures and personal protection (p<0.05) :AOR (95%CI: 5.1(2.2- 11.9), 3.9(1.7-8.7), 5.0(2.3-10.7), 3.1(1.4-7.1); respectively. In addition, being a male, higher education and longer duration of employment (≥ 15 years) has affectedsignificantly the practice of standard work procedures (p<0.05): AOR: 2.4 (1.2-5.0), 3.0 (1.2- 8.02), 2.2(1.0-4.7); respectively. Lastly, personal protection is significantly affected by duration of employment (p<0.05) (AOR (95%CI):3.06(1.2-7.4) (Table 4).

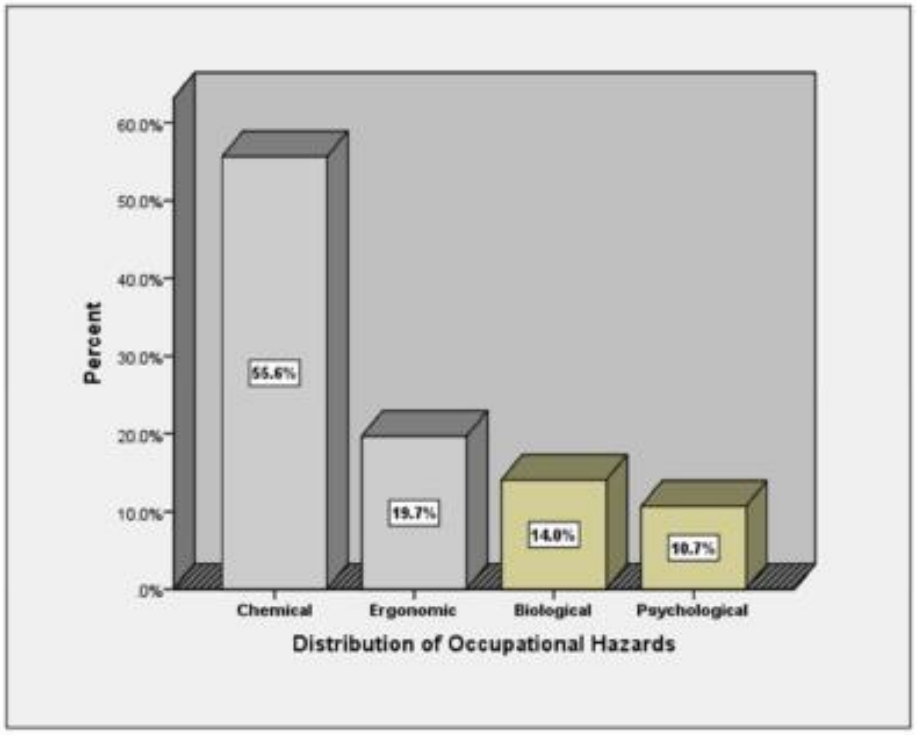
	General measures	Lab work area	Work Procedures	Personal protection
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Sex Male Female (r)			2.4 (1.2-5.0)	
Education Diploma (r) Specialty training	--	4.3 (0.9-20.1)	----	7.0 (0.8-56.0)

Type of hospital MOH (r) University hospital	--		3.0 (1.2- 8.02)	
Duration of employment <15 years (r) ≥ 15 years	--		2.2(1.0-4.7)	3.06(1.2-7.4)
Knowledge Bad (r) Good	5.1(2.2-11.9)	3.9(1.7-8.7)	5.0(2.3-10.7)	3.1(1.4-7.1)

The most frequently reported occupational hazards were chemical hazards (55.6%) followed by ergonomic hazards (19.7%) and biological hazards (14%) (Figure 1).

The most frequently reported occupational hazards of moderate severity is chemical hazards (31.5%) followed by biological hazards (24.2%). Also, the mostfrequently reported as severe hazards are chemical hazards (38.2%) followed by biological hazards (5.6%) (Results are not tabulated).

The hazards were classified as moderate or severe according to self-reported subjective classification based on Likert scale (from 1-5)



Discussion

Medical laboratory is considered potentially as hazardous workplace. Lab staff are exposed to many biological hazards in addition to physical and chemical incidents. Despite that the laboratory employees had some knowledge about safety measures in workplace, there were obvious disparities in their attitudes andpractices.

The mean age of the studied group was 35.7 (9.0) and more than half of them (51.1%) were female. Regarding years of experience; about two thirdof workers had worked for < 15 years (58.4%) (Table 2). This finding wasin line with Mahmoud and Sabry(2019), who revealed that > 50% of thelaboratory workers in governmental hospitals in Benha City aged 30-40 years. As regards gender the finding was not in line with the same referencewho revealed that more than two third of laboratory workers were males.

However, these findings were inaccordance with Abode (2013); whostudied profession hazards related tomedical laboratories in Libya and foundthat approximately two thirds of them were females, and the majority had < 10years of experience.

About 80% of the studied laboratory workers are diploma holders and work in university hospitals (79.2%) (Table 2). These findings support a study doneby Awad (2017) that indicated that morethan 50% of the sample had secondary education while the rest (less than 50%)had a high education or a postgraduate degree. Similarly, a comparableresearch from Kenya reported that mostof participants had at least a diploma level of education (78.43%) (Misra et al., 2001).

About 62 % of the studied labtechnicians were vaccinated againsthepatitis B (results are not tabulated), which is similar to what was detected by Fateen et al. (2021) who found that50.4% of the pathology allied healthstaff in the children's hospital; Lahore,India was vaccinated.

The mean score for occupationalhealth knowledge among the studiedpostgraduate laboratory technician students was 30.8; less than half had good knowledge (47.2%) (Table 1). In a related study in Ahmedabad cityin India, Zaveri (2012), detected that knowledge, attitude, perception, and compliance among laboratory workers were poor, only 20.8% of them had positive knowledge.

The current study results showed good occupational safety practices inlaboratories (Table3). In consistence with our findings, a study that was carried out to evaluate the knowledge and practices of laboratory standard precautions (LSP) in Yemen and found that 38% of workers had good knowledge of LSP and 32% of them had good practice of LSP (Al-Abhar et al., 2017).

There were a statistically significantly difference in occupational health knowledge scores among the studied group as regards to age, gender, education and employment duration ($p<0.05$). The higher knowledge scoreswas noticed among the older age group(≥35 years), males, master degree workers and senior workers (≥ 15 years)(Table 2). In agreement with these resultsMahmoud and Sabry (2019) assessed quality of laboratory in microbiology laboratories of 4 Ministry of Health- related hospitals in Alexandria and reported high statistically significant differences between the total knowledgescores of laboratory employees in termsof age, sex, education level, job nature,experience years, and history of trainingprograms ($p < 0.001$). The present findings also were in harmony with Zenhom et al. (2012) from Alexandria , Egypt, who reported that the yearsof experience and training courseshad significant effects on the level of knowledge among laboratory workers, where workers who worked for more than 10 years' experience and with training courses had best test results andperformance level.

Lab safety practice scores were significantly higher among the studied group as regards age (<35 and ≥ 35years) including general measures, lab work area, work procedures and

personal protection with noticed better practice in older age group ($p<0.05$).In addition, there are higher practicescores among males compared to females with statically significant difference ($p<0.05$). There has been significantly higher lab safety practice among workers ≥ 15 years than the <15years ($p<0.05$) duration of employment(Table 3). This could be due that males need to be aware about safety procedures because they are more prevalent in technical positions and work in private laboratories. Females, on the other hand, might tend to take some time off, such as maternity leave,and don't necessarily work full time. They therefore possess less experience than men. These results disagree witha Malaysian study which reported that women had better knowledge, attitudes and practices about workrelated hazards and therefore are less susceptible to work related harm (Nettoand Rahmawati, 2017).

Higher education and good knowledge were significant predictors for good practice among the studiedgroup (Table 4). Similarly, a study in Yemen which agreed on the observationthat higher education is liked to better knowledge and practices and explainedtheir findings by better opportunities tolearn about the biosafety (Al-Abhar et al., 2017).

However, another study from Saudi Arabia reported that sex, education level and years of experience did not reveal significant association with safety practices among laboratory workers. Themean score was greater among femalescompared to males (Thirunavukkarasu et al., 2021). Alshalani and Salama, 2019 in their study on assessment of occupational safety practices among medical laboratory staff in governmentalhospitals in Riyadh, Saudi Arabia noticed that positive score improved by increase in years of experience and education level.

Chemical hazards were the most often reported occupational risks (55.6%), followed by ergonomic risks (19.7%) and biological risks (14%) among the studied group (Figure 1).These results came in agreement with a study done in Italy on research lab workers and found that 54.4% of them were exposed to chemical hazards(Papadopoli et al., 2020).

Also these results were consistent with a study on Scientific Laboratory Workers of the Public University in Lebanon (No = 220) which reported that 45.0% have had accidents; the main cause was exposure to chemicals (73.7%) and more specifically by inhalation (45.4%). Females (85.9%) were more exposed to accidents than males (Nasrallah et al., 2022).

Regarding occupational hazard severity, the most frequently reported one of moderate severity was chemical hazards (31.5%) followed by biological hazards (24.2%). Also, the most frequently reported as severe hazards were chemical hazards (38.2%)followed by biological hazards (5.6%) (Results are not tabulated).

Alqam (2013) from Al-Quds University, Palestine in his study onoccupational hazards among laboratory workers in Palestinian governmental hospitals reported that the biologic and chemical hazards were the most severe occupational hazards faced bythe participants. Authors explained that because of the nature of the laboratory works. The lowest percentwere for ergonomic and psychologicalhazards.

Conclusion

Less than 50% of studied laboratory technician had adequate knowledge towards occupational health and safety measures. There was significant association between knowledge of occupational health safety measures and age, education and durationof employment. Also, knowledge andeducation were significant predictorsfor good safety practice.

Recommendations

The laboratory staff should receive regular training on laboratory safety. Hospitals should set up an effective, ac- tive, and well-implemented occupational safety programs under the supervision of safety officers. The curriculum course involving safety awareness and preventive measures needs to be intensified in national technical institutes. Applying administrative and engineering controls in alaboratory environment can significantly reduce ergonomic hazards. Chemical hazard assessment is required to implement safety measures according to hazardous chemical exposure. Safety plans can be tailored according to each lab based on risk assessment. Adequate training in themanagement of accidents and first aid for hazardous chemicals is required.

References

1. Al-Abhar N, Al-Gunaid E, Moghram G, Al-Hababi A, Al Serouri A et al. (2017): Knowledge and Practice of Biosafety Among Laboratory Staff Working in Clinical Laboratories in Yemen. Appl Biosaf; 22(4): 168–71. https://doi. org/10.1177/1535676017733451

2. Akagbo SE, Nortey P and Ackumey MM (2017): Knowledge of standard precautions and barriers to compliance among healthcare workers in the Lower Manya Krobo District, Ghana. BMC Research Notes; 10(1): 432. DOI:10.1186/s13104-017-2748-9.

3. Alshalani AJ and Salama KF (2019): Assessment of Occupational Safety Practices Among Medical Laboratory Staff in Governmental Hospitals in Riyadh, Saudi Arabia. Journal of Safety Studies; 5(1): 1-23.

4. Alqam T (2013): Occupational hazards among laboratory workers in Palestinian governmental hospitals in the West Bank: Master thesis. Al-Quds University Palestine. Available at https://dspace.alquds.edu/ server/api/core/bitstreams/f62a6831-44d6- 4a78-ad99-14e7f121112a/content.Last accessed 15 November 2022

5. El-Gilany AH, El-shaer S, Khashaba E, El- dakroory SA and Omar N, (2017):Knowledge, attitude, and practice (KAP) of 'teaching laboratory' technicians towards laboratory safety and waste management: a pilot interventional study. J Hosp Infec; 96(2):192- 4. Available at http://dx.doi.org/10.1016/ j.jhin.2017.02.007

6. Kaplan M and Emin EM (2018): The effect of the perceptıon of occupational health and safety on job stress: a research in a public hospital. [Article in Turkish]. Mukaddime;9(2):181–94.

7. Mahmoud A and Sabry S (2019): Safety Training Program for Laboratory Workers regarding Prevention of Occupational Hazards. Am J Nurs Res; 7(2):116-27

8. Manyele SV, Ngonyani HM and Eliakimu E (2008): The status of occupational safety among health service providers in hospitals in Tanzania. Tanzan J Health Res; 10(3): 159-65.

9. Misra UB, Agawu K, Parmar NK and Bhahrar R (2001): An Epidemiologic Study of Biohazard in a Microbiology Laboratory at a Large Teaching Hospital. J Academic Hospital Administration; 12: 12.

10. Nasrallah IM, El Kak AK, Ismaiil LA, Nasr RR and Bawab WT (2022): Prevalence of Accident Occurrence Among Scientific Laboratory Workers of the Public University in Lebanon and the Impact of Safety Measures. Saf Health Work; 13(2):155- 62. https://doi.org/10.1016/j.shaw.2022.02.001.

11. Netto EF and Rahmawati T (2017): Predictors of knowledge, attitude and practices on work related injuries among laboratory staffs in a public university in Malaysia. International Journal of Public Health and Clinical Sciences; 4(5): 139-57.

12. Nisii C, Castilletti C, Di Caro A, Capobianchi M R, Brown D, et al. (2009): The European network of Biosafety-Level-4 laboratories: Enhancing European preparedness for new health

threats. Clin Microbiol Infect; 15(8): 720-6. https://doi. org/10.1111/j.1469-0691.2009.02946.x.

13. Occupational Safety and Health Administration (2011): Laboratory safety guidance. US Department of Labor OSHA; 2011. p. 3404e3411R. Available at https://www.osha.gov/sites/default/ files/publications/OSHA3404laboratory-safety-guidance.pdf

14. Papadopoli R, Nobile CG A and Trovato A (2020): Chemical risk and safety awareness, perception, and practices among research laboratories workers in Italy. J Occup Med Toxicol; 15:17. https://doi. org/10.1186/s12995-020-00268-x

15. Reda S, Gebrehiwot M, Lingerew M, Keleb A, Wagaye B et al. (2021): Occupational blood exposure beyond needle stick injuries: hospital- based cross-sectional study among healthcare workers in governmental hospitals of Northern Ethiopia. BMC Health Services Research: 21(1):1136. DOI: 10.1186/s12913-021-07167-9.

16. Senthil A, Anandh B, Jayachandran P, Thangavel G, Josephin D et al. (2015): Perception and prevalence of work-related health hazards among health care workers in public health facilities in southern India. Int J Occup Environ Health; 21(1): 74-81. DOI:10 .1179/2049396714Y.0000000096.

17. Sewunet T, Kebede W, Wondafrash B, Workalemau B and Abebe G (2014): Survey of safety practices among hospital laboratories in Oromia Regional State, Ethiopia. Ethiop J Health Sci; 24(4):307-10. PMID: 25489194; PMCID: PMC4248029 [PubMed].

18. Shafiq A, Barkat A, Shabnam K, Anum F, Muhammad S et al. (2019):A Survey on Biosafety Practices in Lab Personnel in 12 Selected Areas of Karachi, Pakistan. J Biosaf Biosecur ; 1 (1): 68-72. ISSN: 2588-9338.

19. Shekhar H, Patel M, Jain C, Garg N and Mangukiya K (2015): Awareness to health hazards and biosafety precautions among laboratory technicians working in tertiary- care center in Rajasthan, India. Int J Med Sci Public Health; 4:15–18.

20. Shnawa ZK (2017): Chemical Safety in Chemistry Departments Laboratories at Iraqi Universities. Iraqi National Journal of Chemistry; 17(2); 149-56.

21. Smith TD and DeJoy DM (2012): Occupational injury in America: An analysis of risk factors using data from the General Social Survey (GSS). J Safety Res: 43(1): 67-74. https:// doi.org/10.1016/j.jsr.2011.12.002.

22. Tait FN, Mburu C and Gikunju J (2018): Occupational safety and health status of medicallaboratories in Kajiado County, Kenya. Pan Afr Med J; 23: 29-65. DOI:10.11604/ pamj.2018.29.65.12578. PMID: 29875946;

23. Thirunavukkarasu A, Alrawaili KA, Al-Hazmi AH, Dar UF, ALruwaili B et al. (2021): Prevalence and Risk Factors of Occupational Health Hazards among Health Care Workers of Northern Saudi Arabia: A Multicenter Study. Int J Environ Res Public Health; 18(21):11489. DOI: 10.3390/ ijerph182111489.

24. Fateen T, Shafqat F, Saqlain N and Ahmed A (2021): Knowledge, Attitude and Practices of Laboratory Safety Measures among Allied Health Staff of Pathology. Pak Pediatr J; 45(2): 211-15

25. Tohda S (2016): Infection Control from the Viewpoint of Medical Safety by Our Clinical Laboratory in TMDU Hospital. Rinsho Byori; 64(3), 334-7.

26. Zaveri J (2012): Knowledge, Attitudes and Practice of Laboratory Technicians Regarding Universal Work precaution. Natl J of Med Res; 2(1): 113-5.

27. Zenhom I, Saber A, Nasrm A and Moustafa S (2012): Bacteriological Laboratories- / Quality, Alexandria University. High Institute of Public Health -Department of Microbiology; P.74.