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Assessment of the Knowledge of Biosafety Amongst Medical Laboratory Personnel: A Case Study of Federal Medical Centre, Katsina NigeriaAnas Babangida^{1*}, Aliyu Bala², Hauwa Bako³, Mujahid Abdullahi¹, Ahmad Mohammad Bello⁴, Mahmud Inusa Yandutse¹Chemical Pathology Department, Federal Medical Centre, Katsina Nigeria ¹, Haematology Department, Federal Medical Centre Katsina Nigeria ², Department of Medical Laboratory Science, Ahmadu Bello University, Zaria Nigeria ³, Department of Medical Laboratory Sciences, Bayero University Kano Nigeria ⁴.**Author for Correspondence***: ababangida76@gmail.com. <https://dx.doi.org/10.4314/sokjmls.v8i2.20>**Abstract**

Laboratory safety is the state of being safe and free from avoidable accidents that may result in injury, loss of lives and valuable property in the analytical laboratory. Medical laboratory personnel are prone to biological, chemical, electrical and mechanical risks. The study was aimed at assessing the knowledge of medical laboratory personnel on biosafety. Eighty-nine (89) medical laboratory staff stratified based on professional cadre were enrolled for the study through volunteer sampling between April and June, 2020. Data was obtained using self-administered questionnaires, cleaned and analyzed using simple descriptive statistics of frequencies and percentages with SPSS version 16.0. Out of the eighty-nine (89) potential participants, sixty-three (63) responded by completely filling out the questionnaires. 54.0% (n=34) of the respondents have had formal training on laboratory biosafety. 17.5% (n=11) were aware that a safety manual existed in the laboratory though only 11.1% (n=6) were familiar with its contents. 27.0% (n=43) knew how to operate fire extinguishers using the standard protocol, 87.3% (n=55) possessed moderate knowledge of personal protective equipment, while 69.8% (n=44) and 55.6% (n=35) knew the steps for donning and doffing respectively. General assessment of the medical laboratory personnel on biosafety showed paucity of knowledge about waste segregation/disposal, routes of exposure to laboratory chemicals, components of safety incidence report and periodic review of laboratory and safety manuals. Training and re-training of medical laboratory personnel on biosafety is paramount in order to minimize occurrence of laboratory accidents and improve the quality of services rendered in the medical laboratory.

Keywords: Medical Laboratory, Biosafety, Nigeria.**Introduction**

Biomedical Laboratory Safety (BLS) is the application of knowledge, techniques and equipment to preclude staff, laboratory and the environmental exposure to potentially infectious agents (Medical Laboratory Science Council of Nigeria, 2020). A typical medical laboratory is associated with different risks, ranging from mechanical, chemical, electrical, fire accidents to biohazards including blood and other bodily fluids leading to infections from infectious organisms and their toxins, as a result, requires great care and constant vigilance (Marlon and Limaie, 2020). Issues concerning laboratory safety are not given adequate attention by both employees and the employers in the developing countries (Wader *et al.*, 2013) and safety checks are not always in place or implemented (Shobowale *et al.*, 2015). According to the African Society of Laboratory Medicine, huge advances in strengthening laboratory medicine have been established in Africa, but there exist serious lapses in adequate laboratory biosafety and biosecurity measures (African Society for Laboratory Medicine, 2020).

Safe practices help in protecting healthcare workers, patients and visitors from health hazards (Nazir and Kadiri, 2017). The risk of acquiring infection through exposure to body fluids due to inadequate infection control process is substantial (Federal Ministry of Health Ethiopia, 2012). In general, healthcare workers are highly exposed to hazards which greatly impair their health and quality of life, with multiplier effect on their immediate family and extended members (Occupational Safety and Health Administration, 2014). The Occupational Safety and Health Administration (OSHA) has mandated the use of PPEs by all health care workers who are exposed to patients' blood and other bodily fluids to protect against Human Immunodeficiency Virus (HIV),

Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) infections that may result from an accidental exposure (National Institute for Occupational Safety and Health, 2010; Sravan *et al.*, 2016).

Fire safety is an important component of any building infrastructure (Ikpae *et al.*, 2018) and provision of fire safety equipment like portable fire extinguishers, emergency exit and fire hydrant as well as training of Medical Laboratory personnel on how to use them is necessary (Ikpae *et al.*, 2018). The aim of the study is to assess the knowledge of Biomedical Laboratory Safety (BLS) amongst Medical Laboratory Personnel (MLP) of Federal Medical Centre (FMC) Katsina.

Materials and Method

Study Area and Population

The study was conducted in Katsina, Katsina State, North-western Nigeria. Eighty-nine (89) personnel of the Medical Laboratory Department of FMC Katsina served as the potential participants out of which sixty-three (63) participated in the study. The study population comprised Medical Laboratory

Scientists, Pathologists, Medical Laboratory Technicians and Laboratory Attendants. Relevant data was acquired using a structured self-administered questionnaire. Written informed consent was obtained from all study participants prior to filling out the questionnaires.

Statistical Analysis

Data obtained was entered into Microsoft excel sheets, cleaned and was analysed using Statistical Package for Social Sciences Version 16.0. Results are presented as simple descriptive statistics of frequency and percentages.

Ethical Approval

Approval to carry out the study was obtained from the Ethical Research Committee (ERC) of Federal Medical Center, Katsina. Ref :(#FMCNHREC, REG. NO03/082012, Dated 2nd March, 2020).

Results

Response Rate = $63/89 \times 100 = 70.79\%$

Table 1.0: Socio-demographic Characteristics of Study Participants

Characteristics	n (%)
Age group (years)	
21-29	13 (20.7)
30-40	36 (57.1)
40	14 (22.2)
Gender	
Male	44 (69.8)
Female	19 (30.2)
Medical Laboratory Working Experience (years)	
<5	20 (31.7)
5-10	29 (46.0)
11-15	8 (12.7)

16-20	3 (4.8)
21-25	1 (1.6)
26 and above	2 (3.2)
Job Category	
Medical Laboratory Scientists	27 (42.9)
Pathologists	2 (3.2)
Medical Laboratory Technicians	30 (47.6)
Laboratory Attendants	4 (6.3)
Laboratory Safety	
Formal Laboratory Biosafety Training	34 (54.0)
Knowledge of the Availability of a Laboratory Safety Manual	11 (17.5)
Knowledge of Safety Manual Content	6 (11.1)

Table 2.0: Participants' Response to Knowledge of Biosafety

Basic Safety Assessment	Correct Response (%)	Incorrect Response (%)
Knowledge of Fire Safety		
Elements of Fire	44.4	55.6
How to use a fire extinguisher	27.0	73.0
Maintenance of portable fire extinguishers	50.8	49.2
Knowledge of Personal Protective Equipment (PPE)		
Examples of PPE	87.3	12.7
Steps for donning PPE	69.8	30.2
Steps for doffing PPE	55.6	44.4
Attitudes/Awareness on Universal Safety Precautions		
Refrigeration of food and drinks alongside samples and reagents	7.9	92.1
Are biosafety cabinets required for laboratory procedures that generate aerosols	90.5	9.5

	Never	Sometimes	Always
How often hand gloves are worn before commencing work	14.3	39.7	46.0
How often laboratory coats are worn before commencing bench work	12.7	44.4	42.9
Wearing Laboratory Coats outside the Laboratory	57.1	28.6	14.3
Practice of hand washing after laboratory bench work	6.4	11.1	82.5
Waste Segregation and Disposal	Correct Response (%)	Incorrect Response (%)	
Yellow -coloured non-chlorinated bag should be used for disposal of broken/contaminated glassware	22.2	77.8	
Cardboard boxes with blue-coloured marking should be used for the disposal of cotton swabs, syringes, blood bags	11.1	88.9	
Orange is the colour code for highly infectious waste	25.4	74.6	
Sputum samples should be disinfected before disposal	36.5	63.5	
Microbial cultures, blood bags, stocks of microorganisms should be pre-treated with a non-chlorinated chemical before disposal	19.0	81.0	
General Safety Assessment			
Knowledge of elements of laboratory safety	58.7	41.3	
Examples of safety equipment	57.1	42.9	
Routes of exposure to chemicals in the laboratory	22.1	77.9	
Reasons for maintaining Material Safety Data Sheets	69.8	30.2	
Examples of dangerous goods in the medical laboratory	50.8	49.2	
Who is responsible for laboratory safety	46.0	54.0	
Components of safety incidence report	20.6	79.4	
Knowledge of laboratory management of chemicals	55.6	44.4	
Proper way of handling sharp objects in the medical laboratory	73.0	27.0	
Exhibiting unprofessional attitudes in the laboratory	76.2	23.8	
Knowledge of types of laboratory Manuals	15.6	84.4	
Knowledge of timed review of laboratory safety manual	34.0	66.0	

Table 3.0 Positive Responses of Study Participants based on Laboratory Professional Cadre

Basic Safety Assessment	Medical Laboratory Scientists n(%)	Medical Laboratory Technicians n(%)	Pathologists n(%)	Laboratory Attendants n(%)
Knowledge of Fire Safety				
Elements of Fire	12(44.4)	12 (40.0)	1 (50.0)	3 (75.0)
How to use a fire extinguisher	8 (29.6)	7 (23.3)	1 (50.0)	0 (0.0)
Maintenance of portable fire extinguisher	15 (55.6)	15 (50.0)	1 (50.0)	0 (0.0)
Knowledge of Personal Protective Equipment (PPE)				
Examples of PPE	25 (92.6)	25 (83.3)	2 (100)	3 (75.0)
Steps for donning PPE	22 (81.5)	18 (60.0)	2 (100)	2 (50.0)
Steps for doffing PPE	13 (48.1)	18 (60.0)	1 (50.0)	3 (75.0)
Attitudes/Awareness on Universal Safety Precautions				
Refrigeration of food and drinks alongside samples and reagents	26 (96.3)	29 (76.7)	2 (100)	3 (75.0)
Are biosafety cabinets required for laboratory procedures that generate aerosols	27 (100)	26 (86.7)	2 (100)	2(50.0)
How often hand gloves are worn before commencing work	17 (63.0)	9 (30.0)	1(50.0)	2 (50.0)
How often laboratory coats are worn before commencing bench work	10 (37.0)	15 (16.7)	1 (50.0)	1 (25.0)
Wearing Laboratory Coats outside the Laboratory	17 (63.0)	15 (50.0)	0 (0.0)	2 (50.0)
Practice hand washing after laboratory bench work	24 (88.9)	23 (76.7)	2 (100)	2 (50.0)
Waste Segregation and Disposal				
Yellow-coloured non-chlorinated bag should be used for disposal of broken/contaminated glassware	6 (22.2)	8 (26.7)	0 (0.0)	0 (0.0)
Cardboard boxes with blue-coloured marking should be used for the disposal of cotton swabs, syringes, blood bags	0 (0.0)	3 (10.0)	0 (0.0)	0 (0.0)
Orange is the colour coding for highly infectious waste	6 (22.2)	9 (30.0)	1 (50.0)	2 (50.0)
Sputum samples should be disinfected before disposal	12 (44.4)	10 (33.3)	1 (50.0)	0 (0.0)
Microbial cultures, blood bags, stocks of microorganisms should be pre-treated with a non-chlorinated chemical before disposal	7 (25.9)	5 (16.7)	0 (0.0)	0 (0.0)

Table 4.0: Positive Responses of Study Participants based on Laboratory Working Experience

Basic Safety Assessment	<5years	5-10 Years	11-15 Years	16-20 Years	21-25 Years	>25 Years
Knowledge of Fire Safety						
Elements of Fire	9 (45.0)	15 (51.7)	3 (37.5)	2 (66.7)	0 (0.0)	0 (0.0)
How to use a fire extinguisher	7 (35.0)	7 (24.1)	4 (50.0)	3 (100)	0 (0.0)	0 (0.0)
Maintenance of portable fire extinguisher	11 (55.0)	15 (51.7)	3 (37.5)	1 (33.3)	1 (100)	0 (0.0)
Knowledge of Personal Protective Equipment (PPE)						
Examples of PPE	17 (85.0)	25 (86.2)	8 (100)	3 (100)	1(100)	1(50.0)
Steps for donning PPE	11 (55.0)	21 (72.4)	6 (75.0)	1 (33.3)	1 (100)	2 (100)
Steps for doffing PPE	9 (45.0)	19(65.5)	5 (62.5)	3 (100)	1 (100)	1 (50.0)
Attitudes/Awareness on Universal Safety Precautions						
Refrigeration of food and drinks alongside samples and reagents	16 (80.0)	28 (96.6)	8 (100)	3 (100)	1(100)	2 (100)
Are biosafety cabinets required for laboratory procedures that generate aerosols	18 (90.0)	23 (96.6)	6 (75.0)	3 (100)	1 (100)	2 (100)
How often hand gloves are worn before commencing work	8 (40.0)	12 (41.4)	5 (62.5)	0 (0.0)	0 (0.0)	1 (50.0)
How often laboratory coats are work before commencing bench work	5 (25.0)	13 (44.8)	5 (62.5)	0 (0.0)	0 (0.0)	1 (50.0)
Wearing Laboratory Coats outside the Laboratory	3 (15.0)	3 (10.3)	3 (37.5)	1 (33.3)	0 (0.0)	2 (100)
Practice hand washing after laboratory bench work	17 (85.0)	22 (75.9)	8 (100)	3 (100)	1 (100)	1 (50.0)
Waste Segregation and Disposal						
Yellow-coloured non-chlorinated bag should be used for disposal of broken/contaminated glassware	2 (10.0)	7 (24.1)	2 (25.0)	1 (33.3)	0 (0.0)	2 (100)
Cardboard boxes with blue-coloured marking should be used for the disposal of cotton swabs, syringes, blood bags	2 (10.0)	3 (10.3)	1 (12.5)	0 (0.0)	0 (0.0)	0 (0.0)
Orange is the colour coding for highly infectious waste	7 (35.0)	0 (0.0)	2 (25.0)	1 (33.3)	1 (100)	0 (0.0)
Sputum samples should be disinfected before disposal	7 (35.0)	10 (34.5)	5 (62.5)	1 (33.3)	0 (0.0)	1 (50.0)
Microbial cultures, blood bags, stocks of microorganisms should be pre-treated with a non-chlorinated chemical before disposal	2 (10.0)	5 (17.2)	4 (50.0)	2 (66.7)	0 (0.0)	1 (50.0)

Discussion

We observed in our study that 17.5% of the respondents knew about the availability of a Laboratory Safety Manual (LSM) in their respective departments. LSM serves as a resource for identifying and evaluating the nature of potential laboratory hazards and how to control them. The lack of knowledge of the availability of such a document as reported by 82.5% of the respondents might be a causative influence for non-compliance with some safety precautions in the laboratory department. We also observed that 54% of our respondents have had formal training on laboratory biosafety. Our finding is similar to 52.4% reported by Shobowale *et al.* (2015), 58.1% reported by Anne *et al.* (2017) and 68% reported by Khabour *et al.* (2018). However, Khabour *et al.* (2018), attributed the findings of increased positive responses to staff participation in a biosafety program either during their education career and/or at their workplace while Anne *et al.* (2017) noted that regardless of the favorable responses of the study participants, the knowledge wasn't reflected in their routine laboratory practice. Despite the significant formal knowledge of our respondents, we observed poor translation into practical implementation by the participants.

Delany *et al.* (2011) also reported that some factors such as lack of training of personnel, work overload, excessive demand for a rapid turnaround time (TAT) and personnel's overconfidence as unavoidable hindrances in adherence to laboratory biosafety. Adinma *et al.* (2009), identified lack of display of universal guidelines, patients perceived to be at low risk for blood-borne pathogens, safety equipment interfering with technical skills and insufficient supply of water as potential interferences for laboratory biosafety.

In our study we observed the dearth of knowledge on fire safety. Twenty-seven percent (27%) of the respondents answered in the affirmative regarding the appropriate steps to extinguish fires using portable fire extinguishers. Our finding is similar to the report of 26% by Ikpae *et al.*, (2017) but contrary to 7% as reported by Sravan *et al.* (2016). In a study

carried out in Lagos, Nigeria, Shobowale *et al.* (2015) reported that 60.3% of the respondents never received any training on how to operate fire extinguishers. The general low-level of knowledge of fire safety among our respondents implies that in the event of a fire accident in the laboratory department, an irreparable catastrophic incident may occur. Sravan *et al.* (2016) recommends inclusion of such contents as fire prevention and control methods in the educational curriculum of health professionals.

Medical laboratory professionals are mandated to wear hand gloves before handling any body fluid or infectious material and are instructed to wash hands after removal of the gloves (Occupational Safety and Health Administration, 2011; Institutional Biosafety Manual, 2020). Considerable significant knowledge was demonstrated by respondents on the steps for donning (69.8%) and doffing (55.6%) personnel protective equipment (PPE). Though the respondents were aware of the PPEs, majority of them don't use them appropriately. We also observed 54.0% and 57.3% adherence to the use of hand gloves and laboratory coats which is in concordance with 62.0% reported by Main *et al.* (2008), but contrary to 92.0% reported by Adinma *et al.* (2008); Akhter *et al.* (2011) and 100% reported by Anne *et al.* (2017). We also observed that 82.5% of the respondents washed their hands after bench work based on their responses which is similar to the finding of Akhter *et al.* (2011) who reported 61.0% compliance to hand washing after laboratory work. Our study found no significant difference between laboratory professional cadre and laboratory working experience as it pertains to the use of PPEs.

General safety assessment of the respondents in our study showed 79.4% were unaware of the components of a safety incidence report. We also observed poor knowledge of waste segregation (19.5%) and disposal (27.7%) which is similar to 12.0% reported by Yeturu *et al.* (2005), but contrary to 83.5% reported by Adogu *et al.* (2014) though the findings of Adogu *et al.* (2014) is influenced by a training received by nurses and healthcare attendants prior to the study. Studies by Aisien *et al.* (2005); Adogu *et al.* (2014); and

Olufemi *et al.* (2015) suggested on-the-job training program, workshops and seminars for healthcare professionals on universal safety precautions.

Conclusion

General assessment of the medical laboratory personnel on biosafety showed paucity of knowledge on waste segregation/disposal, routes of exposure to laboratory chemicals, components of safety incidence report and periodic review of laboratory and safety manuals. Training and re-training of medical laboratory personnel on biosafety is paramount in order to minimize occurrence of laboratory accidents and improve quality of services rendered by the medical laboratory.

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