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Infection Control Practices among Laboratory Healthcare Workers in an Urban Local Government Area of Lagos State, Nigeria

Adeniran A[1], Ojo OY[2], Goodman OO[1], Adebayo BI[1], Oluwole EO[3], Olasubomi IO[4], Kuyinu Y[1]

[1]*Department of Community Health and Primary Health Care, Lagos State University College of Medicine/Teaching Hospital, Lagos, Nigeria.*
[2]*Department of Community Medicine and Primary Care, Federal Medical Centre, Abeokuta, Ogun, Nigeria.*
[3] *Department of Community Health and Primary Care, College of Medicine, University of Lagos, Nigeria.*
[4]*Federal Ministry of Youth and Sports Medicine Department National Stadium Surulere Lagos, Nigeria.*

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Abstract
Objective: Laboratory healthcare workers do handle a wide range of potentially dangerous materials which exposes them to numerous hazards. This study aimed to assess the practices of laboratory health care workers towards safety, infection control, and the associated factors to its practices.
Methods: A cross-sectional study was conducted among 181 laboratory healthcare workers in all registered 33 laboratory facilities in Ikeja Local Government Area in 2017. Data were collected with pre-tested, structured self-administered questionnaires. Data were analyzed with SPSS version 20 and a p-value of < 0.05.
Results: The mean age of respondents was 35.0 ± 2.45 years, most of whom were females (57.7%) and married (61.1%). The majority (98.9%) demonstrated good knowledge of infection control. A total of 62.3% identified hand washing as the most important infection control practice while HIV and Tuberculosis were diseases respondents majorly considered as high risk of contracting. A total of 84.6% of the respondents showed good practices. Limited availability of personal protective equipment in the laboratories was a major barrier identified by 98.1% of respondents. Respondents displayed good knowledge, attitude, and practice of infection control.
Conclusion: The barrier to infection control was the limited availability of personal protective equipment. Therefore, concerted efforts should be mustered to ensure continuous training and retraining with the provision of personal protective equipment.

Keywords: infection control practices, laboratory, healthcare workers, knowledge, attitude

Plain English summary

Adequate efforts should be geared towards the infection control and prevention practices amongst all health care workers in order to improve the health of the people.

Background

The World Health Organisation has stated that infection prevention and control is practical evidence that prevents patients and health care workers from being harmed by avoidable infection (1). It includes the policies and procedures of a hospital or other health facility to minimize the risk of spreading healthcare-associated infections or community-acquired infections to patients or members of the staff (1, 2). Infection in the laboratories has been reported to be caused by pathogens being inhaled in aerosols or through contact, airborne droplets or on snapping-closing specimen containers, dispensing or pipetting infectious fluids, or centrifuging infectious materials in open buckets (3, 4).

Correspondence:
Ojo, Omobola Y
Department of Community Medicine and Primary Care,
Federal Medical Centre, Abeokuta, Nigeria.
+234 07039693874, vinegbogs2007@gmail.com

Laboratory health workers are exposed to a large pool of specimens from patients with infections such as hepatitis B (HBV), hepatitis C (HCV), HIV, Tuberculosis (TB), typhoid fever, other enteric pathogens, and parasitic infections (5, 6).

Worldwide, the healthcare workforce represents 12% of the working population (7), and they encounter diverse hazards due to their work-related activities (8). Substantial morbidity and mortality among these workers inevitably lead to loss of skilled personnel and adversely impact healthcare services which are already strained in many low-and middle-income countries (9). According to the World Health Organization WHO, about 2.5% of HIV cases among Health Care Workers (HCWs) and 40% of HBV and HCV cases among HCWs worldwide are as a result of occupational exposures (10). In a 2002–2004 survey of clinical laboratory directors who participated in ClinMicroNet, an online forum sponsored by the American Society of Microbiology, 33% of laboratories reported the occurrence of at least one laboratory-associated infection (11).

The knowledge of infection control among laboratory staff based on work done so far is generally below average (12, 13). Also, prevalent recapping of used needles, non-compliance with the standard precautions, lack of HBV vaccination, ignorance, lack of regular training of the staff in universal precautions and correct laboratory procedures, and proper waste management among others are still problems (12, 13). Due to the high risk of exposure of medical laboratory staff, there is a need for infection control practices which include all the activities carried out and actions taken daily to restrain, regulate or influence the entry (6), development, and multiplication of infectious agent in the laboratory health care workers.

In Nigeria, there are many infection controls challenges such as the absence of a nosocomial infection surveillance system at a national level and a high prevalence of communicable diseases with over three million people living with HIV and most of which were co-infected with tuberculosis or hepatitis (13). Lack of infection control awareness among health personnel and behavioral problems, both in the community and among the healthcare workers is a major concern (7). In a study done to explore the knowledge and practices of infection control among HCW in a tertiary referral center in North-Western Nigeria, most of the respondents knew of and correctly identified hand washing, avoiding injury with sharps, use of barrier precaution, and hand hygiene as effective strategies for preventing Healthcare-associated infections (HCAI) (12).

A high prevalence of laboratory-acquired infections has been more frequently reported due to lack and non-compliance with universal precautions and standard practices (14). Poor perception of the risk of infections (3), and lack of infection control awareness among health care workers (12) are common in sub-Saharan Africa and developing countries including Nigeria (13).

A qualitative study conducted to assess the facilitators and barriers to infection control practices at a tertiary care hospital in Haryana, northern India identified person, task, and organizational level factors including a high rate of nursing staff turnover, time spent training new staff, limitations in language competency, and heavy clinical workloads as primary barriers to infection control at the hospital (15).

Another cross-sectional study which compared the practice and adherence to WHO infection control guidelines among the health workers in two hospitals in Port Harcourt, Nigeria reported reasons for non-adherence to infection control policy which included poor supervision, lack of in-service training, inadequate supply of consumables, and absence of a hospital's policy on infection control (16).

Identifying existing infection control knowledge and practices among health care workers is paramount in developing a successful infection control program (17). Therefore, research work as this is imperative, as efforts need to be directed towards enhancing awareness of and also ensuring maximal efficient and effective utilization of Infection Control Procedures to achieve various benefits for improvement of public health.

This study sought to assess the knowledge, compliance to safety practices and identified barriers to infection control practices among laboratory healthcare workers in Ikeja LGA of Lagos Nigeria, to identify shortcomings in standard infection control practices, reinforcing control efforts, as well as bridging the probable gap in knowledge.

Methods

Study area

The study was conducted at Ikeja, the capital of Lagos State. It is one of the seven hundred and seventy-four (774) local government areas (LGA) in Nigeria and one of the fifty-seven Local Government/Local council development areas in Lagos. Ikeja has ten wards (18) and an estimated human population of six hundred and forty-eight thousand, seven hundred and twenty (19). Ikeja has both private and public health facilities, the government health facilities

include; four Primary Health Care (PHC) centers, two health posts, and a tertiary hospital: Lagos State University Teaching Hospital (LASUTH). There are hospital-based and private medical laboratories in Ikeja. The number of currently registered medical laboratories (both Government and Private) in Ikeja LGA is thirty-three (19).

Study design and study population
A descriptive, cross-sectional study design was used to assess compliance and barriers to infection control practices among laboratory healthcare workers in Ikeja LGA. All cadres of laboratory healthcare workers in all the registered and functioning medical laboratories in Ikeja LGA who gave informed consent participated.

Sample size determination, Sampling technique
The sample size was calculated using a Fishers' formula with p = 0.879, the prevalence of knowledge of hand washing as the most effective infection control measure (20). q= 1- p (1 – 0.879 = 0.121), d = error of precision at ± 5% (0.05). The calculated minimum sample size was 163, which was adjusted to 181 to make up for 10% non and incomplete responses. All the laboratory healthcare workers (181) working in the 33 facilities were taken as the sample size.

Study instruments and data collection
A self-administered questionnaire was adapted to measure socio-demographic variables such as age, gender, marital status, religion, ethnicity, cadre and years of work experience, the knowledge of laboratory health care workers on infection control with questions on infection control definition, guidelines, and preventive measures, attitude towards infection control with questions such as; opinion about the necessity to always observe infection control practices (ICPs). Also, the most important ICPs, participants' infection control practices were measured with questions on availability and use of infection control guidelines, routinely practiced infection control measures, and training on infection control. It also took cognizance of hand hygiene practice, PPE usage, laboratory cleaning schedule, as well as waste segregation, and barriers to infection control practice.

A pre-tested was conducted among 18 laboratory healthcare workers at another local government in the state. This was carried out to validate the appropriateness of the questionnaire developed. Necessary corrections were made before the questionnaire was used in this study.

Data analysis
Data analysis was conducted using the statistical package for the social sciences (SPSS version 20) software. Descriptive statistics were computed to generate frequencies, mean, and percentages. Knowledge level was assessed by awarding 1 mark for every correct answer, a zero mark for each wrong answer. The total number of marks for each respondent was calculated by summing up the marks obtained. Respondents that scored below the median value were categorized as having poor knowledge while those that scored above it were categorized as having good knowledge (21).
In determining the attitude: 1 mark was awarded for positive or good attitude, a zero mark for a negative or poor attitude. Scores below the median were adjudged to signify a negative attitude while respondents that scored above the median value were adjudged to have a positive attitude (21). In the same manner, 1 mark was awarded for every correct practice response; a zero mark was awarded for every wrong practice. All the scores were added and the median score was calculated. Respondents that scored below the median value were categorized as having poor practice while those that scored above the median value were categorized as having good practice (21). Significance level set at p-value < 0.05. Chi-square and Fisher's exact tests were used to measure the association between categorical variables.

Results
In table 1, the population characteristics of the respondents are presented. The majority were females (57.7%), married (61.1%), and mostly from the Yoruba ethnic group (69.2%). The most prevalent age group was those less than 29 years (37.1%) and the mean age of respondents was 35.0 ± 2.45. A total of 150 respondents (85.7%) practiced Christianity.

Table 1: Sociodemographic characteristics of respondents

Variables	Frequency (n=175)	Percentage
Age group		
< 29	65	37.1
30-39	48	27.4
40 and above	62	35.5
Mean ±SD 35.0 ± 2.45 years		
Gender		
Male	74	42.3
Female	101	57.7
Marital status		
Singled	68	38.9
Married	107	61.1
Religion		
Christianity	150	85.7
Islam	22	12.6
Traditional	3	1.7
Ethnicity		
Yoruba	121	69.2
Igbo	25	14.3
Hausa	13	7.4
Others	14	8.0
No response	2	1.1

'Table 2' shows almost all the respondents have heard of the term 'infection control' (95.4%). The source of this information was mostly through seminars/workshops (63.5%), classroom/lectures (67.7%), and colleagues (51.5%). However, a total of 80.8% showed an understanding of what "infection control" meant. The infection control measures they were aware of were; hand washing (100.0%), Personal protective equipment (93.4%), disinfection (92.8%), sterilization (92.8%), and safe medical waste disposal (88.9%) among others. The infection control practice considered most important was hand washing (62.3%) followed by the use of PPE (48.0%). However, twenty-three respondents (13.1%) reported that some infection control measures were difficult to observe, including isolation (48.5%), sterilization (39.4%), use of personal protective measures (36.4%), disinfection (33.3%), and handwashing (27.3%).

Table 2: Knowledge of respondents on infection control

Variables	Frequency	Percentage
Ever heard of infection control(n=175)		
Yes	167	95.4
No response	8	4.6
Source of information (n=167) *		
Seminar/ Workshop	106	63.5
Co-workers/ colleagues	86	51.5
Textbook /Journals	84	50.3
Media	62	37.1
Classroom/ Lectures	113	67.7
Understanding of the term "infection control" (n=167)		
Good	135	80.8
No response	32	19.2
Heard of infection control guidelines (n=167)		

Yes	147	88.0
No	16	9.6
No response	4	2.4
known or heard control measures (n=167) *		
Hand washing	167	100.0
Personal protective wear	156	93.4
Safe injection and sharps use	146	87.4
Safe medical waste disposal	148	88.6
Isolation	117	70.1
Disinfection	155	92.8
Sterilization	155	92.8
Housekeeping	93	55.7
Others	7	4.2

Multiple responses *

In 'Table 3' More than 80% of the respondents affirmed that their units or sections possess a copy of infection control guidelines while those without it gave reasons such as poor organization (27.3%), non-provision (40.9%), and lack of proper documentation in their laboratory unit (31.8%). The majority of the respondents (78.3%) had read the infection control guideline but 44.4% did not follow the guidelines due to forgetfulness, its unavailability of materials was 22.2%, and high workload (16.7%).

Table 3: Infection control practices by the respondents.

Variables	Frequency	Percentage
Had a copy of the infection control guidelines		
Yes	144	82.3
No	22	12.5
No response	9	5.2
Reason for not having a copy of the guideline in the unit (n=22)		
Lack of proper documentation	7	31.8
Poor organization	6	27.3
Not provided	9	40.9
Ever read the infection guideline		
Yes	137	78.3
No	18	10.3
No response	20	11.4
Frequency of use of infection control guideline		
Occasionally	33	18.9
Often	20	11.4
Always	87	49.7
Never	6	3.4
No response	29	16.6
Reasons why the guideline was not followed (n=18)		
Forgot	8	44.4
Differences in each unit as regards infection control practices.	1	5.6
High workload	3	16.7
Material unavailability concerning waste disposal	4	22.2
Believing that I know all the basics in the guideline	2	11.1

As shown in 'Table 4', the major barrier to adequate infection control was the limited availability of personal protection equipment (98.1%), limited time to attend seminars

/workshops on infection control was 47.3%, lack of provision for post-exposure prophylaxis (40.3%), non-availability of color-coded waste bags for waste segregation (39.6%), non-availability of sharps/ puncture-proof bins (36.9%) and excessive workload due to staff shortage, making it practically impossible to carry out proper hand hygiene procedures (25.7%).

Table 4: Barriers to infection control in the laboratory

Barriers to infection control	Agree Freq (%)	Disagree Freq (%)	Indifferent Freq (%)	Total Freq (%)
Limited availability of Personal protection equipment (PPE)	99 (98.1)	2 (1.9)	0 (0.0)	101 (100)
Limited time to attend seminars/ workshops on infection control	69 (47.6)	72 (49.7)	4 (2.7)	145 (100)
Colour coded waste bags for waste segregation are not always available	59 (39.6)	84 (56.4)	6 (4.0)	149 (100)
Lack of political will on the part of the management towards workers' safety	58 (42.0)	71 (51.5)	9 (6.5)	138 (100)
No provision for post-exposure prophylaxis	56(40.3)	70(50.3)	13(9.4)	139(100)
Sharps/ Puncture-proof bins are not always available	55 (36.9)	89 (59.7)	5 (3.4)	149 (100)
Soap, alcohol hand rub/ sanitizers are not always available	53 (35.3)	91 (60.7)	6 (4.0)	150 (100)
There is an inadequate water supply for proper handwashing	51 (33.6)	99 (65.1)	2 (1.3)	152 (100)
Unavailability of policy on infection control guidelines	49(33.1)	88(59.5)	11(7.4)	148(100)
Excessive workload due to staff shortage, making it practically impossible to carry out proper hand hygiene between laboratory procedures	39(25.7)	108(71.0)	5(3.3)	152(100)

In ‘Table 5, almost all the respondents who participated in this research showed good knowledge of infection control practices. The majority also expressed good attitude and practices except for 17.1% and 15.4% respectively.

Table 5: Evaluation of respondents’ knowledge, attitude, and practice of infection control.

Parameter	Poor Freq (%)	Good Freq (%)	Total Freq (%)
Knowledge	2 (1.1%)	173 (98.9%)	175 (100.0%)
Attitude	30 (17.1%)	145 (82.9%)	175 (100.0%)
Practice	27 (15.4%)	148 (84.6%)	175 (100.0%)

Table 6’ shows that there was no statistically significant association between respondents’ age, gender, staff cadre, post-qualification experience, and their practice of infection control ($p>0.05$). However, there is a statistically significant association between the year of training of good practices of infection control. A higher proportion of respondents who attended training on infection control between the years 2016 and 2017 (the year of this study and the year before) had good infection control practices compared to those who had training later($p<0.05$).

Table 6: Association between respondents’ infection control practices and their sociodemographic characteristics

Variables	Practice			Test of significance	
	Good Freq (%)	Poor Freq (%)	Total Freq (%)	χ^2	p value
Age					
<40	96(85.0)	17(15.0)	113(100.0)		
40 and above	52(83.9)	10(16.1)	62(100.0)	0.03	0.849
Total	148(84.6)	27(15.4)	175(100.0)		
Gender					
Male	62(83.8)	12(16.2)	74(100.0)		

Female	86(85.1)	15(14.9)	101(100.0)	0.1	0.835
Total	148(84.6)	27(15.4)	175(100.0)		
Staff cadre					
Lab. Scientist	97(84.3)	18(15.7)	115(100.0)		
Junior Staff	43(82.7)	9(17.3)	52(100.0)	0.1	0.788
Total	140(83.8)	27(16.2)	167(100.0)		
Post Qualification Experience					
≤ 5	35(74.5)	12(25.5)	47(100.0)		
6 – 10	45(86.5)	7(13.5)	52(100.0)	2.7	0.257
>10	43(84.3)	8(15.7)	51(100.0)		
Total	123(82.0)	27(18.0)	150(100.0)		
Most recent training					
2017	64(85.3)	11(14.7)	75(100)		
2016	36(92.3)	3(7.7)	39(100)	6.3	0.042*!
2015 and later	45(73.8)	16(26.2)	61(100)		
Total	145(82.9)	30(17.1)	175(100)		

*Statistically significant.! fisher's p-value

Discussion

Healthcare-associated infections have been closely associated with increased morbidity and mortality among hospitalized patients and predispose healthcare workers to an increased risk of infections (20). To this end, the knowledge of infection control is essential among the laboratory health care workers to ensure safety while discharging duties. Nearly all (95.4%) of the respondents have heard of infection control and its guidelines but only 80.8% displayed a good understanding of its definition. There was a good knowledge of infection control in this study which was in contrast to what was obtained from other studies which stated that opinion of infection prevention and control guidelines are based on evidence collected in acute care settings and therefore are not always practical or appropriate in the facility where resources are more constrained (22, 23). Also, the good knowledge of infection control practices displayed by the respondents was in line with recommendations in the infection control guideline (24). Furthermore, the participants demonstrated good knowledge of the use of Personal Protective Equipment (PPE) such as safety glasses, laboratory coats, footwear, hand gloves, and face shields while rendering laboratory services, this is in synergy with a report which further enumerated the protective roles of PPE against contracting infection when used properly (25).

From this study, antiseptic soaps, water, and alcohol-based hand rubs were the most frequently suggested method of ensuring adequate hand hygiene in the laboratory, and this is in line with WHO guidelines on hand hygiene in health care (26). In addition, respondents' perception that healthcare workers must wear gloves during work activities that involve wound dressing, blood transfusion, surgical operation, giving an injection, obtaining specimen or sample processing is rightly in line with the recommendations that gloves should be worn for both direct and indirect contact with blood, body fluids or mucous membranes given from a study done in Malaysia (27).

Only 62.3% of the respondents considered hand washing as the most important infection control practice and this did not demonstrate their good practices to infection control in the laboratory. This was in contrast to the study results of some earlier researchers that proper hand hygiene was the single most important, simplest, and least expensive means of reducing the prevalence of laboratory-acquired infections and the spread of antimicrobial resistance (28, 29). Moreover, respondents were more concerned with being at a high risk of contracting tuberculosis and HIV from specimen handling. Their attitude toward these health conditions was justified with healthcare workers being enlisted among the high-risk populations for tuberculosis (30), while the risk of contracting HIV might be associated with the nature of the disease being a blood-borne transmission that occurs predominantly by percutaneous or mucosal exposure of workers to the blood or body fluids of infected patients as reported by Beltrami EM and et al (31).

The good practice recorded concerning the usage of infection control guidelines was similar to what was obtained from another study (23)

since standard precautions were designed to protect health workers from getting contaminated. However, only 44.4% of them followed the recommendations in the guideline and the low adherence to standard precaution reported can have negative consequences on workers, patients, and institutions and these were also being supported by another study (32). The major factors that prevented usage of the guidelines were forgetfulness, non-availability of infection control materials, and high workload. This is consistent with the reasons identified for low adherence earlier reported in another study (32). The infection control measure routinely practiced by respondents ranged from hand washing, using gloves, wearing laboratory coat, disinfection, sterilization, waste segregation, and disposal of sharps in a puncture-proof bin agree with other studies (33, 34). Whereas among all the measures, isolation was observed as the poorly practiced control measure, a possible reason could be because simple protective isolation offered no advantage over routine care for most immune-compromised patients (34, 35).

Training of laboratory workers as was experienced by almost 80.0% of the respondents in this study had been recognized as a strategy to protect workers from exposure to pathogens and impact their adherence to a standard guideline. This was in close similarity with a study done in another African country (35). This study also highlighted the significant roles played by the colleagues at work in disseminating information on infection control which was near was obtained in other studies (23, 34).

The high level of hygiene maintained in the laboratory by the respondents demonstrated their detailed understanding of infection control practices, except for more than 40% of the studied population that recap needles after use. Contrary to this practice, recapping needles are considered extremely dangerous as health care workers have been primarily infected with HIV after needlestick and sharps injuries (36, 37). The high overall knowledge (98.9%), and practice (84.6%) of infection control among the respondents studied indicated that there was a successful implementation of infection prevention and control in their facilities which was also what was obtained in a study done in two tertiary institutions in Nigeria (38).

The major barriers to infection control practices in this study were limited availability of personal protection equipment, lack of political will of the management towards worker's safety, lack of provision for post-exposure prophylaxis and sharps/puncture-proof bins not always available (15). These reports were in the same line with earlier studies in China where further reports included occurrences of occupational accidents, particularly exposure to potentially contaminated biological materials and sickening of health workers (39).

Only the most recent training received by the respondents exhibited a significant relationship with the knowledge of infection control practices. The capacity building undergone by the laboratory scientists could account for the significant impact of the good knowledge displayed. A similar result of laboratory scientists demonstrating good knowledge of infection control has been reported in Edo (40). This is consistent with the deductions that in terms of infection control, knowledge, and practice (KAP) surveys can identify knowledge gaps, cultural beliefs, or behavioral patterns that may impede infection control efforts (41).

Conclusions and Recommendations.

The study showed that despite the good knowledge and good practices demonstrated by the respondents to infection control and safety, there was limited availability of personal protective equipment for them. The training and retraining of these laboratory health workers will be an added advantage.

Declarations

Ethics consideration

Ethical approval was obtained from the Health Research Ethics Committee of Lagos State University Teaching Hospital (LASUTH) with reference number LREC/06/10/901. Informed consent was obtained from the respondents before the administration of the questionnaire after the purpose of the study has been explained to respondents.

Consent for publication

Availability of data and materials

All data generated or analyzed in this study are included in this article and are available at any request.

Competing interests

The authors declare that they have no competing interests

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None

Contributions of authors

AA: Involved in data curation, analysis/ production of results, validation, interpretation, critical review of the manuscript.

OOY**:** Involved in the methodology, did a critical review of the paper, validation, visualization, original draft preparation, and editing of the manuscript for publication.

OIO**:** Involved in methodology, data collection, analysis, and manuscript writing.

GOO: Review, edited the work, and engaged in the draft presentation of the manuscript.

ABI: Supervision, review the work, and did project administration.

OEO: Involved in the validation, review, and editing of the work for publication.

KY: Conceptualisation, original draft, and design of the work, supervision, data collection tool, interpretation, review, and editing of the work.

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