Antibiotic resistant *Staphylococcus spp* isolates colonizing some College students Laboratory coats

ABSTRACT

Aim: Laboratory coats may act as fomites for the continued dissemination of antibiotic resistant bacteria. This study aimed at detecting the level and type of antibiotic resistant microorganisms' on laboratory coats of students of Dora Akunyili College of Pharmacy, Igbinedion University Okada, Edo State. Nigeria.

Place and Duration of Study: Dora Akunyili College of Pharmacy, Igbinedion University Okada, Edo State. Nigeria between September and October, 2020.

Methodology: A total of 20 pharmacy students working in various laboratories in the college were included in the study to evaluate the bacterial contamination of laboratory coats. Swabs were obtained from 3 different areas of the laboratory coat – collar, pocket, and wrist and processed in the Pharmaceutical Microbiology laboratory based on standard microbiological techniques. Antibiotic susceptibility testing was carried out on the isolates obtained by Kirby-Bauer method for 8 antibiotics.

Results: This study revealed that 83% of the coats were contaminated with *Staphylococcus spp.* White coats of male subjects were more contaminated than that of the female subjects and the pockets were sites which had the highest percentage of finding bacteria. Antibiotic sensitivity testing showed isolates on the laboratory coats resistant to cloxacillin, erythromycin, ceftriaxone, cefuroxime, ceftazidime, augmentin and oxacillin.

Conclusion: The detection of antibiotic resistant isolates of *Staphylococcus spp* from the laboratory coats of pharmacy college students suggests that the clothing may harbor pathogenic organisms. This study also highlights the importance of laboratory coats as potential source of cross infection.

Keywords: Antibiotic resistant, *Staphylococcus spp*, College students, Laboratory coats

1. INTRODUCTION

A white coat or laboratory coat is a knee-length overcoat worn by experts in the medical field or by those involved in science laboratory work (Akanbi II et al., 2017). Generally, the white coat is associated with standard of professionalism and care especially in the medical field. On the other hand, these white coats are known to be potentially contaminated with pathogenic bacteria (Wong et al., 1991).Laboratory coats are an essential item for laboratory personnel to wear to avoid chemical contamination on the laboratory worker's clothing and skin. In spite of following strict infection control protocols and precautions carried out in the laboratory, unknowingly many micro-organisms are carried on white coats. Medical and paramedical students commonly wear their white coats on when required and also in places not required like the cafeteria, library, and even off the campus (Muhadi et al., 2007). A previous study confirmed that white coats of medical students are more likely to be bacteriologically contaminated at points of frequent contact, such as sleeves and pockets. The main microorganism identified in the previous study was *Staphylococcus aureus* (Wong et al., 1991). Other viable infectious organisms such as *Clostridium difficile*, vancomycin resistant *Enterococci* have been recovered from the white coat of health workers (Nurkin, 2004; Siegel et al., 2007). A previous study also showed that *Staphylococcus aureus* was the most common bacterial contamination of the white coats of health care workers followed by coagulase negative *staphylococci* (Muhadi et al., 2007; Asima et al., 2012). Transmission of infections between patients within health care facilities has also been associated with transient harboring of pathogens in health care workers and students clothing including white coats which may act as a means for the continued transmission of bacteria. This study aimed at detecting the level and type of antibiotic resistant microorganisms on laboratory coats of students in Dora Akunyili College of Pharmacy, Igbinedion University Okada, Edo State. The student's attitude towards handling the laboratory coats and cleaning them, as well their view towards laboratory coat contamination also were investigated.

2. MATERIALS AND METHODS

2.1 STUDY SITE AND DESIGN

This study was carried out in Dora Akunyili College of Pharmacy, Igbinedion University Okada, Edo State. Approval from the University ethical committee was duly obtained for this study. The ethical document IUOETC/21/003 was initiated for the study.

2.2 STUDY POPULATION

Twenty pharmacy students who volunteered for participation in this study were included, of which 10 were males and 10 were female students. A self-administered questionnaire was used to obtain data and information on the laboratory coat handling and laundry habits of each participant. The variables used in obtaining the information included gender, accommodation (hostel, home), laboratory coat sleeve (short, long), method of carrying the laboratory coat (bags, hands, shoulder), location of the use of the laboratory coat (only in the laboratory, in and outside the laboratory), when the laboratory coat was last washed (3 days or less, 1week, 2-4weeks, 1month or more), the frequency of washing (once in 3 days, once in a week, 2-4 weeks, more than a month), type of cleaning (home or laundry), the wearer's perception of whether the coat was clean: if it has no stains, whether they perceive their laboratory coat to be clean if the collar and pockets were clean, whether they consider their coat to be contaminated with or without stains and whether they believed if their laboratory coats carried germs and were possible agents of transmission of pathogens.

2.3 SAMPLE COLLECTION

The sample collections were performed in the region of the collar, wrist and pocket (labelled a,b,c respectively) of the user's dominant hand (right-handed or left handed). The swabs which were used were plain, cotton-tipped and sterilized swabs. Normal saline was used to moisten the swabs before obtaining the sample by passing the swabs up and down three times on the desired areas and the swabs were sent immediately to the laboratory for culturing.

2.4 ISOLATION AND IDENTIFICATION OF *STAPHYLOCOCCUS* SPP

The sample swabs were immediately inoculated on already prepared Mannitol Salt agar plates and the plates were incubated overnight at 37^0C. Distinct colonies formed were randomly selected from culture plates. Pure cultures were obtained afterwards on agar slants maintained at 4^oC in the refrigerator throughout the study. The colonies obtained were identified by using standard techniques (Cheesebrough 2006). Tests carried out to obtain the identity of the isolates include Gram staining test, citrate test, catalase test, urease test and coagulase test

2.5 ANTIMICROBIAL SUSCEPTIBILITY TESTING

The Kirby-Bauer susceptibility testing technique (Bauer et al., 1966) was carried out. A 10^{-2} dilution of the isolates was prepared for all isolates. 0.1ml of each isolate was introduced into the pre-prepared Muller Hinton Agar plates and surface plated using a sterile swab sticks. The isolates were tested with 10 antibiotics which include; ofloxacin, erythromycin, cloxacillin, gentamycin, augmentin, ceftriaxone, ceftazidine, cefuroxime, oxacillin and vancomycin. Incubation was performed at 37^oC for 24hours and results were also interpreted using EUCAST criteria (EUCAST, 2019).

3. RESULTS

Table 1-4 show the results of the questionnaires given to the students to obtain information on the subjects and their attitude towards handling and laundry of their laboratory coat.

Table1: Basic information of subjects included in this study

	Number of students (n=20)	Percentage (%)
Gender		
Male	10	50
Female	10	50
Accommodation		
Hostel	19	95
Home	1	5
Laboratory coat sleeve		
Short	0	0
Long	20	100

Table 2: Attitude towards handling laboratory coat

How do you carry your laboratory coat?	Number of students (n=20)	Percentage (%)
Bags	8	40
Hands	9	45
Shoulders	3	15
Frequency of usage of laboratory coat		
Only in the laboratory	11	55
In and outside the laboratory	9	45

When was your laboratory coat last washed?	Number of students (n=20)	Percentage (%)
3 days or less	7	35
1 week	3	15
2-4 weeks	6	30
1 month or more	4	20
How often do you wash your laboratory coat?		

Once in 3 days	4	20
Once in a week	9	45
2-4 weeks	5	25
More than a month	2	10
Type of cleaning		
Laundry	2	10
Home wash	18	90

Table 3: Practice of laundry of laboratory coat

Table 4: Knowledge with regards to laboratory coat

Do you perceive your lab coat to be clean if it has no stains?	Number of students (n=20)	Percentage (%)
Yes	15	75
No	5	25
Do you perceive your lab coat to be clean if collar and pockets are clean?		
Yes	15	75

No	5	25
Do you consider your lab coat to be contaminated with or without stains?		
Yes	10	50
No	10	50
Do you think your lab coat carries germ?		
Yes	20	100
No	0	0
Do you believe that lab coats can be a potential transmitting agent for pathogens?		
Yes	15	75
No	5	25

Out of the 60 Samples (including from the collar, wrist and pockets of the lab coats) that were collected from 20 students and inoculated on Mannitol Salt Agar (MSA), microorganisms were isolated from 29 samples including 7 (35%) contaminated coats of the female students and 9 (45%) coats of the male students. Table 5 shows the results of the sites of the laboratory coat where microorganisms were isolated from.

Table5: Sites from which organisms were isolated

Organism	Collar	Wrist	Pocket	Total

	10 (34%)	7(24%)	12(41%)	29

Twenty four isolates were confirmed as *Staphylococcus spp* among the isolates obtained. All the *Staphylococcus spp* isolates were Gram positive cocci, catalase positive, coagulase positive, urease positive and citrate positive. Table 6 is a summary of the antibiotic sensitivity test result of the *Staphylococcus spp* isolates. 92% (22/24) of the isolates were observed to be susceptible to ofloxacin. Only 4% (1/24) of the isolate was sensitive to gentamicin. All the isolates were observed to be 100% resistant to ceftriaxone, cefuroxime, ceftazidime, oxacillin and augmentin showing no zone of inhibition. For sensitivity of the isolates to vancomycin, EUCAST standards report disk diffusion method of vancomycin susceptibility as unreliable and cannot distinguish between wild type isolates and those with non-vanA-mediated glycopeptide resistance.

Table 6 Antibiotic susceptibility test results of the isolates

ANTIBIOTICS	% of isolates showing resistance
OFL	2 (8%)
CXC	22 (92%)
ERY	22 (92%)
CTR	24 (100%)
GEN	23 (96%)
CRX	24 (100%)
CAZ	24 (100%)
AUG	24 (100%)
OXA	24 (100%)
VAN	X

Key: OFL: Ofloxacin [5mcg] CXC: Cloxacillin [5mcg] ERY: Erythromycin [5mcg] CTR: Ceftriaxone [30mcg] GEN: Gentamicin [10mcg] CRX: Cefuroxime [30mcg] CAZ: Ceftazidime [30mcg] AUG: Amoxycillin + Clavulanate [30mcg] OXA: Oxacillin [1mcg] VAN: Vancomycin [30mcg] mm: X- EUCAST standards report disk diffusion method of vancomycin susceptibility as unreliable and cannot distinguish between wild type isolates and those with non-vanA-mmediated glycopeptide resistance.

4. DISCUSSION

Over the years, the white coat adds value to the medical profession (Muhadi et al., 2007) but previous reports have been shown them to harbor pathogenic organisms and so may have a role in the transmission of pathogenic microorganisms (Wong et al., 1991; Neely, 2000; Muhadi et al., 2007). This study revealed high bacterial contamination of laboratory coats of pharmacy students in Dora Akunyili College of Pharmacy in Igbinedion University Okada, Edo state. A possible reason for the high contamination rate could be that the students indiscriminately used the laboratory coats even outside the laboratory. Microorganisms have been shown to attach and survive on fabrics which are used to make white coats, which include cotton, cotton and polyester, or polyester materials for between 10-98 days (Chacko et al., 2003; Uneke et al., 2010). This could be another reason for the high bacterial contamination observed. This could also form a route of transmission of pathogenic microorganisms if adequate inhibitory processes/ procedures are not carried out (Wiβmann et al., 2021). Our results correlate with previous studies that reported high bacterial contamination rate of white coats (Wong et al., 1991; Treakle et al., 2000; Pilonetto et al., 2004; Srinivasan et al., 2007; Uneke et al., 2010; Mwamungule et al., 2015; Qaday et al., 2015; Khan et al., 2020; Kumar et al., 2020).

The laboratory coats of 20 pharmacy students who were working in various laboratories in the college were studied. Of the 10 white coats which belonged to the male subjects 9 (45%) were contaminated, while of the 10 white coats which belonged to the female subjects, 7 (35%) were contaminated. Previous

reports confirm the bacterial contamination of white coats higher in males compared to female subjects (Asima, 2012; Akanbi II et al., 2017). This could possibly be due to the fact that the male gender are of the habit of keeping some of their belongings such as cell phones, pens in their pockets while the female gender on the other hand have alternative way of keeping all these items specifically in their hand bags (Akanbi II et al., 2017). This study also correlates with the findings of previous studies (Neely, 2000; Loh, 2000; Sande et al., 2015) where the pockets were sites which had the highest percentage of finding bacteria. This could possibly be due to the fact that the pocket is a site of frequent contact, thus it has a higher possibility of harboring bacteria. Although, 15 (75%) subjects perceived their white coats to be clean, even without stains and were also aware that the coats could act as potential transmitting agents for pathogenic organisms. The data from the washing practices of the students revealed that most of the students had washed their white coats within the past 1 week (50%) and a contamination rate of 48% was obtained which contrast to the findings of a study which was conducted by Asima et al., in 2012 who found in their study a high contamination rate (62%-78%) in spite of the fact that that most (71%) of the students had washed their white coats within the past 1 week. This result also contrasts with the findings of Wong et al., 1991, who reported that high microbial counts on white coats regardless of the time in their use.

In this present study, *Staphylococcus spp* were the most commonly isolated organism which is consistent with other studies that reported *Staphylococcus* aureus as the predominant organism contaminating white coats (Treakle et al., 2000; Muhadi et al., 2007; Asima et al., 2012; Saxena et al., 2013; Qaday et al., 2015). Results from this study contrasts from the findings of a study in which diphtheroids were the most common organisms isolated (Uneke et al. 2010).

Result of the antimicrobial susceptibility test shows significantly that all the *Staphylococcus spp* isolated from the laboratory coats were resistant to most of the antibiotics tested including Oxacillin. Only Ofloxacin was found to have inhibitory activity on the isolates. The detection of resistant strains of *Staphylococcus* spp from the laboratory coats of students confirms that the clothing may harbor pathogenic organisms. As a result of frequent dermal contact, laboratory coats can also harbor resistant bacteria which could possibly enhance the contamination of laboratory coats as they are often touched in the course of work. Guidelines should be followed for frequent hand washing before and after experiments and also good handling and washing procedures of laboratory coats should be adopted (Zakariah et al., 2021). One of the limitations of the study is that the sample size was small and a control group of non-worn laboratory coats was not included in the study.

5. CONCLUSION

As a result of the pathogenic potential of isolates recovered from laboratory coats of healthy Pharmacy students in Igbinedion University Okada, further investigation is required to further evaluate the possible roles of these coats in the transmission of bacteria. Efforts should be made to limit the use of laboratory coats outside the laboratories in the College and also proper laundry of laboratory coats should be

frequently carried out. Students having more than one laboratory coat is another precaution that can be taken to reduce the degree of contamination in the environment.

COMPETING INTERESTS

Authors declare no competing interests exist

ETHICAL APPROVAL

Approval from the University ethical committee was duly obtained for this study. The ethical document IUOETC/21/003 was initiated for the study.

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