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Research Article

Identification of Microbial Isolations from the Clinical Aprons of Graduates and Post-Graduate Trainees in a College Department

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Abstract

Aim of the Study: To determine the microorganisms present on the white aprons of the students, interns and post-graduates in the Department of Oral and Maxillofacial Surgery outpatient department.

Settings and Design: A survey of the random sample consisted of 18 white aprons of dental students, interns and postgraduate students were done over a period of one week who agreed to participate in the study.

Methods and Material: Sample consisted of 18 white aprons of dental students, interns and postgraduates, three most representative locations of each apron were analyzed, over a period of six working days, who agreed to participate in the study. For each participant, three sites of their aprons were selected for microbial collection by the way of using a sterile cotton swab: sleeve, pocket and lapel. Normal saline was used to moisten the swabs before collecting the sample by passing the swabs up and down, twice on the desired areas and they were immediately sent for microbial culture. The swabs that were received by the department of microbiology were immediately streaked onto blood agar and McConkey agar and the plates were incubated overnight at 37^0C. The colonies obtained were identified by using standard techniques. Antibiotic sensitivity testing was done by Mueller-Hinton agar.

Results: Out of the 18 participated, 48% (95% CI = 34.8% to 61.4%) were contaminated with *Staphylococcus (staph.) aureus* and from that, 18.5% [95% confidence interval (CI) = 8.1% to 28.9%] were contaminated with Methicillin Resistant *Staph. aureus* (MRSA), 7 identified on the lapel (26.9%), 11 identified on the pocket (42.3%) and 8 identified on the sleeve (30.8%).

Keywords: White Apron; Bacterial Contamination; Nosocomial Infection; MRSA

Abbreviations

MRSA: Methicillin-Resistant *Staphylococcus aureus*; CONS: Coagulase Negative *Staphylococcus aureus*; PPE: Personal Protection Equipment

Introduction

Antibiotic-resistant microorganisms and nosocomial infections, they are the biggest threats even in developed countries like the United States of America. Despite having improved infection control measures, health care workers, always knowingly or unknowingly become the carriers for nosocomial infections. Mortality or morbidity rates associated with nosocomial infections or subsequent multidrug-resistant organisms are significantly higher than with an individual having the susceptible forms of identical organisms. These microorganisms to which the healthcare workers get exposed ranges from bacteria, viruses, fungi, worms, and ectoparasites that, provided with pathogenic activity, enables them to inflict maximal incapacitation to the affected individual.

There has been a recent influx of immigrant workers in our institutional feeding areas with questionable medical histories and is dominating the current local population. Noticing this trend, it was decided to evaluate the microbial transfers from the present amalgam of patients and the regular day-to-day interactions of the students, interns, and post-graduates when they are wearing the protective apron.

Aim of the Study

The aim of the study was to determine the microorganisms present on the white aprons of the students, interns and post-graduates in the Department of Oral and Maxillofacial Surgery outpatient department.

Materials and Methods

The present study was conducted in the Department of Oral and Maxillofacial Surgery, Kannur Dental College, Kerala, in association with the Department of Microbiology, Kannur medical college, Kannur, after obtaining institutional ethics committee approval.

This centre caters to the needs of a broad rural population, providing both inpatient and outpatient care.

The study population consisted of final year students, interns and post-graduates in the Department of Oral and Maxillofacial Surgery, Kannur dental college, Kannur. They were divided into three categories, consisting of both male and female participants, and the representatives of each group were randomly selected. All the participants were verbally and individually asked for their participation and compliance in the study and were given instructions for the maintenance of their white aprons for the day selected for their sampling. Once agreed, they were made to sign the informed consent form. A total of six working days was determined as the time-period of the study, with a single representative from each group for each day, totalling up to 18 samples. No individual was tested twice. The participants were advised to bring clean, freshly laundered white aprons for the day allocated to them.

All the white aprons selected for the study were made of cotton-polyester mix material, full sleeves and comprising of two pockets at the bottom half on each side. For the collection of the sample, we selected three representative areas, which is considered to have the most incidence of microbial contamination- the lapels, the pocket mouths and the sleeves. As per previously published studies are areas that come in contact with patients and objects frequently; therefore, are thought to have greater microbial contamination. Three sterile saline-moistened swabs were used for each apron, sampling from each of the locations above, covering both dominant and non-dominant hand sides. Swabs used were plain, cotton-tipped, sterilized and were carried in cotton plugged sterile test tubes.

The participants were to bring the aprons and submit it to the chief investigator. All the participants were given time duration to wear the coat and were limited to a fixed number of cases and outpatients they could check wearing the aprons. Moreover, they were to follow the standard sterilization and asepsis protocols using personal protection equipment (PPE) while performing the procedures. Except for these, rest of their day was to be continued as it is. Their time started at nine in the morning to three in the evening. Once the specified time was over, they were to report to chief investigator for the collection of the samples from the pre-determined locations. Concurrently, they were given a short questionnaire to be filled for the collection of data, which were prepared taking guidance from previously published studies [1].

Individual swabs were used for each location. After moistening the swab tips, they were swiped over, twice, in a swift up and down motion at their designated locations. Three swabs represented each area of the lab coat, with nine swabs per day for six days, surmounting to fifty-four swabs. Once collected, swabs were replaced in their test-tubes, packed in Styrofoam containers and was transferred immediately to the department of microbiology, Kannur dental college.

Swabs were promptly received by the department of microbiology and were immediately streaked onto blood agar, and Mc Conkey's agar; followed by overnight incubation at 370C. Colonies were identified based on their specific tests, and in indicated samples [2], antibiotic sensitivity testing was done by Mueller-Hinton Agar medium.

Results

Demographic data of the identified microorganisms is represented in table 1. The data obtained from the questionnaires were arranged and is described in tabular form in table 2. Figure 1A, 1B, 1C represents the microorganisms found and their incidence in each location. Figure 2A, 2B, 2C, 2D represents the different mediums, colonies, and antibiotic sensitivity test used. Figure 3 depicts the graphical representation of the total microbial incidence.

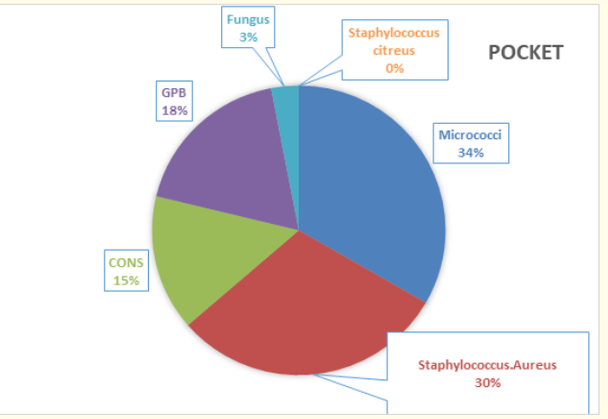

Figure 1A: Microbial incidence in pockets

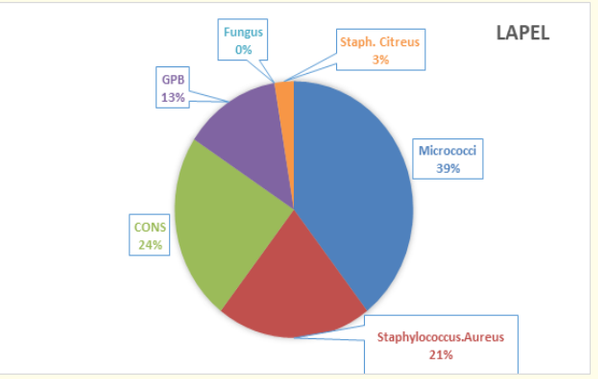

Figure 1B: Microbial incidence in lapels.

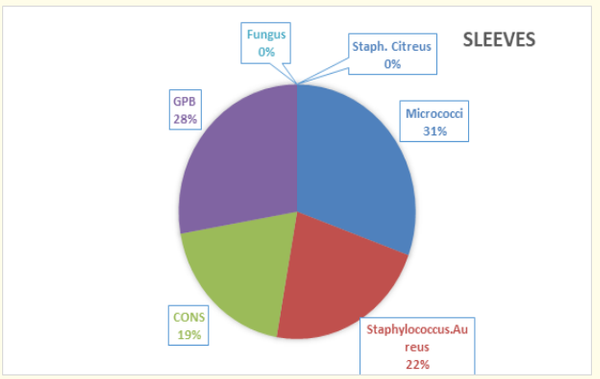

Figure 1C: Microbial incidence in sleeves.

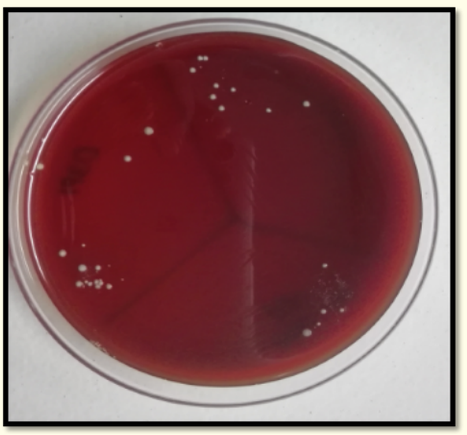

Figure 2A: Blood agar colonies after 24 hours.

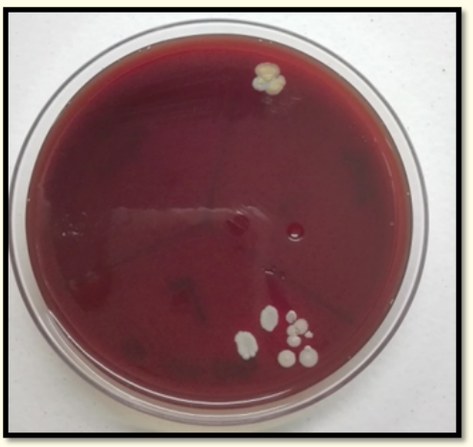

Figure 2B: Blood agar with colonies after 48 hrs.

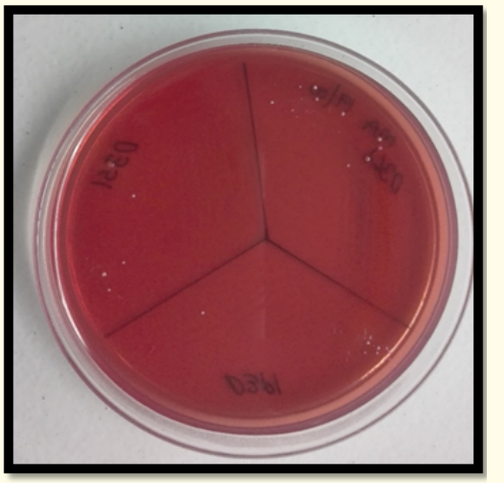

Figure 2C: Mc Conkey agar with colonies.

Figure 2D: Muller-Hinton agar antibiotic Susceptibility testing.

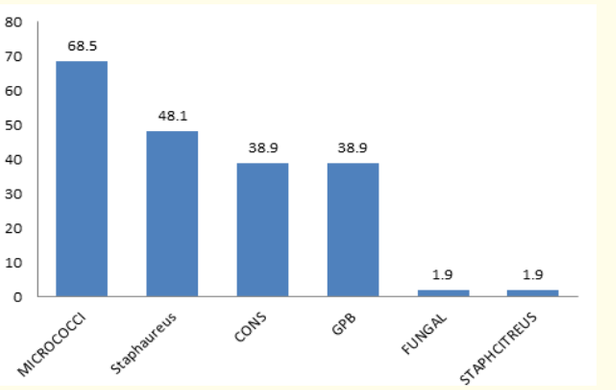

Figure 3: Graphical representation of the percentage of total microorganisms isolated from the clinical aprons.

		Frequency	Percent	Valid Percent	Cumulative Percent
Staphylococcus aureus	A	28	51.9	51.9	51.9
	Valid P	26	48.1	48.1	100.0
	Total	54	100.0	100.0	

Table 1a: Frequency of micrococci with cumulative percentage.

			Frequency	Percent	Valid Percent	Cumulative Percent
Micrococci	Valid	A	17	31.5	31.5	31.5
		P	37	68.5	68.5	100.0
		Total	54	100.0	100.0	

Table 1b: Frequency of Staphylococcus aureus with cumulative percentage.

			Frequency	Percent	Valid Percent	Cumulative Percent
Fungus (Mucorales)	Valid	A	53	98.1	98.1	98.1
		P	1	1	1.9	100.0
		Total	54	100.0	100.0	

Table 1c: Frequency of fungus with cumulative percentage.

			Frequency	Percent	Valid Percent	Cumulative Percent
Coagulase-negative *Staphylococcus aureus* (CONS)	Valid	A	33	61.1	61.1	61.1
		P	21	38.9	38.9	100.0
		Total	54	100.0	100.0	

Table 1d: Frequency of Coagulase Negative Staphylococcus aureus with cumulative percentage.

			Frequency	Percent	Valid Percent	Cumulative Percent
Staphylococcus citreus	Valid	A	53	98.1	98.1	98.1
		P	1	1	1.9	100.0
		Total	54	100.0	100.0	

Table 1e: Frequency of Staphylococcus Citreus with cumulative percentage.

			Frequency	Percent	Valid Percent	Cumulative Percent
Gram-Positive Bacilli (GPB)	Valid	A	33	61.1	61.1	61.1
		P	21	38.9	38.9	100.0
		Total	54	100.0	100.0	

Table 1f: Frequency of GPB with cumulative percentage.

Table 1: Frequency-percentage interval of identified microorganism.

	1. The reasons to wear clinical coat	
To cover clothing	2	11.11%
To appear professional	7	38.88%
Dress code of hospital	14	77.77%
For usage of pockets	1	5.5%
Any other		
	2. How do you carry your clinical coat	
Cover	2	11.11%
Bag	9	50%
Hands	5	41.66%
Shoulder	2	11.11%
	3. Frequency of usage of clinical aprons	
Only hospital	2	11.11%
Canteen	9	50%
Library and reading room	8	44.44%
Outside the college and hospital premises	15	83.33%
Classes	14	77.77%
	4. Type of cleaning	
Laundry	1	5.5%
Home wash	17	94.4%
	5. Do you perceive your clinical coat to be clean if it has no stains	
Yes no	9 9	50% 50%
	6. Do you perceive your clinical coat to be clean if collar and pockets are clean	
Yes no	10 7	55.55% 38.88%
	7. Do you consider your clinical coat to be contaminated with or without stains	
Yes no	17 1	94.4% 5.5%
	8. Do you think your clinical coat carries germs	
Yes no	16 2	88.88% 11.11%
	9. Do you believe that clinical aprons can be a potential transmitting agent for pathogenesis	
Yes no	15 2	83.33% 11.11%

Table 2: Frequency of GPB with cumulative percentage.

The relevant revelations of the statistical analysis is as follows:

1. The participants included 6 trainees (33.3%), 6 interns (33.3%), and 6 PGs (33.33%).

2. 68.5% (95 CI = 56.4% to 80.9%) were contaminated with micrococci 38.9% (95 CI = 25.9% to 51.9%) were contaminated with CONS 38.9% (95 CI = 25.9% to 51.9%) were contaminated with GPB.1.9% (95% CI = -1.7% to 5.5%) were contaminated with fungus 1.9% (95% CI = -1.7% TO 5.5%) were contaminated with *Staph. citreus*.

3. Overall, 48% (95% CI = 34.8% to 61.4%) were contaminated with *Staphylococcus (Staph.) aureus* and from that, 18.5% [95% confidence interval (CI) = 8.1% to 28.9%] were contaminated with Methicillin Resistant *Staph. aureus* (MRSA).

4. Among 26, contaminated with *S. aureus*, 7 identified on lapel (26.9%; CI = 9.8% to 43.9%), 11 identified on pocket (42.3%; CI = 23.4%to 61.2%) and 8 identified on sleeve (30.8%; CI = 13.1% to 48.5%)

5. Among 10 contaminated with MRSA, 3 identified on lapel (30%, CI = 1.6% to 58.4%), 2 identified on pocket (20%; CI = -4.7% to 44.7%), 5 identified on sleeve (50%; CI = 19.1% to 80.9%).

6. Out of the 18 clinical aprons examined, 6 were males (33.33%), and 12 were females (66.66%). Out of the total 18 aprons examined, all the three areas of the study contaminated in 16 aprons (88.88%) (91.6% females and 83.3% males of the total study).Only two areas contaminated in one coat (5.5%) and only one area contaminated in one coat (5.5%).

7. Out of 18 sleeves examined, single colony obtained from 3 aprons (16.6%) and two colonies obtained from 7 aprons (38.8%) polymicrobial colony obtained from 6 aprons (33.33%) and no growth observed in 2 aprons (11.11%).

8. Out of the 18 lapel region examined, single colony obtained from 3 aprons (16.66%), two colonies obtained from 12 aprons (66.66%) and polymicrobial colonies obtained from 3 aprons (16.66%).

9. Out of the 18 pocket region examined, single colony obtained from 2 aprons (11.11%) and two colonies from 10 aprons (55.55%) and polymicrobial colony observed from 3 aprons (33.33%). No colonies observed in one coat (5.5%).

10. These results suggest that, of three regions examined, the total number of colonies obtained is 126, out of which 55 colonies from (43.65%) pocket region, 36 colonies from lapel region (28.5%) and 35 colonies from sleeve area (27.7%).

11. Also, polymicrobial contamination is more in sleeve area (33.33%), followed by pocket region (27.7%) and lapel area (16.6%).

Discussion

The clinical apron itself brings dignity to the profession. It helps for easy identification and made doctors look more professional [3]. However, improper handling practices are the main culprits in the development of omnipresent potential nosocomial pathogens and their spread by the wearer. The patients always shed infectious microorganisms in the hospital environment and are inadvertently carried by the healthcare provider. They are most susceptible to colonisation and temporarily colonized hands aid transmission. The management of these spreading is becoming menacing in the current scenario. This study was performed to evaluate the microbial contamination of clinical aprons of trainees, interns, and post-graduates in Department of Oral and Maxillofacial Surgery. Because of the high frequency of patients and patient contact, it was reasonable to expect some amount of bacterial colonization, but they also included some highly virulent organisms.

The organisms that were identified from three different location of this study includes *Micrococci*, Coagulase-negative *Staphylococcus aureus* (CONS), Gram-Positive Bacilli (GPB), Fungus, and *Staphylococcus citreus* and *Staphylococcus aureus.*

Micrococci are considered to be a saprotrophic organism. Its presence is deemed to be normal on both animate and inanimate objects. Because of this, any occurrence of this organism cannot be regarded as exclusive during infections. They become pathogenic when they are subjected to individuals having compromised immune status and they most commonly cause bloodstream infections. CONS are also a commensal that has gained notoriety recently as a potential pathogen, specifically for causing nosocomial infections. They are regarded a major culprit in causing nosocomial infections and septicemia, especially when the patient is immune compromised [4,5]. Twelve species of CONS has been identified as typical commensals from the healthy skin and anterior nares, the most abundant being *Staphylococcus epidermidis*, followed by *Staphylococcus aprophyticus*, and has managed to carve a unique medical niche by causing nosocomial infections. Gram-positive bacillus is classified based on their ability to form spores. In this, the non-spore forming bacillus is a facultative anaerobe while the *Clostridium* is obligate anaerobe. Their notoriety comes from their ability to produce nosocomial infections, resulting in morbidity or mortality, in newborn infants. Mucorales belong to the order of Zygomycetes and are the agents for the disease traditionally called as mucormycosis. It is fulminant disease culminating in high rates of mortality and morbidity. They are also notorious for affecting the immunocompromised patients [6-13].

The principal pathogen of importance that was found in this study belongs to the *Staphylococci* groups that are *Enterobacter* bacteria. Being facultative anaerobic gram-negative cocci, they are mainly found in the skin and mucosa and are of three types: *Staphylococcus aureus, Staphylococcus epidermidis* and *Staphylococcus haemolyticus*. Increased vulnerability is seen in healthcare professionals (HCP), and the mode of transmission is through colonised hands. In this, an important aspect is the identification of Methicillin Resistant *Staph. aureus* (MRSA).

The detection rate of MRSA on the gowns or gloves of HCPs in either a standardised or routine setting has been reported from as low as 4% and as high as 67% [14,15]. Studies have shown that MRSA has an increased tendency to be retained in the hands of the HCP even after the wearing and removal of gloves and gowns [16]. Studies have shown that the incidence of MRSA nosocomial infections is 52.3% and has been associated with a mortality rate of 15% - 69% [17-19]. MRSA became widespread at the beginning of 1980's although it was first identified in 1961 [20]. When treating MRSA infections, they do not respond to most β-lactam antibiotics, which constitute the initial line of empirical antibiotic therapy. This eventually leads to a delay in initiating an effective antibiotic treatment for its management, which can attribute to the increased mortality and morbidity rates for MRSA induced septicemia. These increased rates can also be attributed to differences in the intrinsic virulence of the microbes, the slower bactericidal effect of glycopeptides compared to β-lactams against *S. aureus* infections, and host factors [20]. They also affect both healthy and immune-compromised patients, but with an affinity towards the immune-compromised.

All the above results conform to the findings of multiple studies regarding the microbial incidence on the clinical aprons of the HCPs. From the questionnaire distributed, we can see that the participants of this research had worn their clinical aprons outside the department (83.33%), which also may have contributed to the presence of the organisms. Another factor to be considered is that the participants themselves washed the clinical aprons and the type, location, and the method used for washing may also play an important role. In an interview with the participants, it was revealed that most of them wore the clinical aprons for more than 2 - 3 days without washing, and sometimes even more. They all perceived their aprons to be dirty but took it for granted. Chacko., *et al.* [21] have demonstrated that there can be survival of microorganism on clinical-aprons between 10 - 98 days and he recommends that all the clinical aprons should be cleaned each day or a maximum of 3 days without washing. Pydi., et al. studied about the white coat contamination of preclinical and clinical dental students and he found that clinical students white coat harboured more pathogenic microorganisms [15-17]. Muhadi., *et al.* found that sleeves and pockets of long-sleeved coats and just pockets of short sleeved coats are contaminated with increased bacterial load [16,17].

Although for the -purpose of this study, they had washed their clinical aprons; it's not the same for the other days. The use of clinical aprons for multiple days without washing will itself result in the exchange of organisms from the environment to the operator to the patient. It has been observed in various studies that the professionals often tend to neglect the presence of diseases caused by biological agents and that these agents can contaminate their work environment. From this, we can safely assume that there is some amount of secondary transfer of organisms to the operator's normal clothing, which is then transferred to the members of their home. This mostly affects the children and the elderly because of their compromised immune status. Because of the continuous exposure to the microorganisms, the dentists themselves might be immune to the contaminant, but it's not the same for the patient. Although not immediate, its results may be exhibited in the long-term.

From the data we have obtained from this study, it is emphasised to meet the standards for the prevention of risks to both the operator and the patient and a third person. Because of the proximity of the operator to the patient during the treatment, the dentist runs several risks of biological contamination. It is not exclusive to patient-dentist contact but can also occur due to patient-instrument or dentist-instrument contact. Although it cannot be contained, the dentist should take every step possible to prevent their spread. Simple actions such as washing before and after each patient go a long way in containing the spread of the infection. Most of the participants of the current study were carrying coats outside the department premises even college campus which again increases the risk of contamination to community people unknowingly as already proven in other studies also [18,20,22]. The trainees should be banned from getting out the respective departments wearing their clinical-aprons. In the questionnaire, some of the participants have marked that they wear these clinical aprons for the professional status (38.88%). This practice should not be encouraged because personal hygiene and the safety of him/herself should be the primary concern of any HCP, not their status quo. The trainees need to follow stricter laundering policies. When it comes to gender, increased contamination is associated with female white coats [16-21].

There have always been concerns surrounding the role of dentists in the spread of pathogenic organisms back and forth. There have numerous studies conducted regarding the same, which has concluded that adequate bio-safety measures should be religiously followed to avoid untoward incidents. One of the measures is the use of personal protection equipment (PPE), including the clinical aprons (apron), masks, goggles, gloves, caps, footwear, among other equipment, and their use depends on the activity being performed and the risks of exposure by health professionals. Clinical aprons, widely used by the dentists, have the potential to act as a double-edged sword because an improperly maintained contaminated clinical coat becomes a source and vehicle for microbial transfer [18,24]. In India as recently an article has been published by Dr Edmond Fernandes, in which he states that easy way to reduce nosocomial infection by India's Ministry of Health would be to ban doctors and students white coat [20]. But the American Medical Association (AMA) has not followed suit to ban the white coat and instead has recommended more research regarding the same [17,20,23].

The main limitation of this study can be attributed to the lack of data before the amalgamation of our treatment population. Hence, we cannot for certainty say that the presence of these virulent organisms was because of the population or they were already persisting. This study is a unicentric study, although it concurs with the various previous published studies, further multicentre study needs to initiated to identify the exact extent of the menace of nosocomial antibiotic-resistant organisms [19].

Conclusion

Considering the microbes identified and their potential pathogenicity for causing nosocomial infections, we can assume that the clinical aprons are potential sources of contamination. Realizing the fact, we should subject the trainees to follow the strict disinfection laundry protocol and emphasize on the usage of clinical aprons elsewhere.

Acknowledgements

Department of Microbiology, Kannur medical college.

Conflict of Interest

No conflicts of interest.

Bibliography

1. Banu A., *et al*. "White aprons as a vehicle for bacterial dissemination". *Journal of Clinical and Diagnostic Research* 6.8 (2012): 1381-1384.

2. Douse J., *et al*. "Should doctors wear white aprons?" *Postgraduate Medical Journal* 80.943 (2004): 284-286.

3. Mayhall CG. "Hospital epidemiology and infection control". Lippincott Williams and Wilkins (2012).

4. Steiner TS and Guerrant RL. "Douglas, and Bennett's principles and practice of infectious diseases" (2010).

5. Spellberg B., *et al*. "Novel perspectives on mucormycosis: pathophysiology, presentation, and management". *Clinical Microbiology Reviews* 18.3 (2005): 556-569.

6. Andriole VT and Lyons RW. "Coagulase-Negative Staphylococcus". *Annals of the New York Academy of Sciences* 174.2 (1970): 533-544.

7. Becker K., *et al*. "Coagulase-negative staphylococci". *Clinical Microbiology Reviews* 27.4 (2014): 870-926.

8. Prabhu RM and Patel R. "Mucormycosis and entomophthoramycosis: a review of the clinical manifestations, diagnosis and treatment". *Clinical Microbiology and Infection* 10.1 (2004): 31-47.

9. Ananthanarayanan R and Paniker CKJ. "Textbook of Microbiology". Orient Longman Pvt. Ltd publisher (2004).

10. Tenorio AR., *et al*. "Effectiveness of gloves in the prevention of hand carriage of vancomycin-resistant Enterococcus species by health care workers after patient care". *Clinical Infectious Diseases* 32.5 (2001): 826-829.

11. Zachary KC., *et al*. "Contamination of gowns, gloves, and stethoscopes with vancomycin-resistant enterococci". *Infection Control and Hospital Epidemiology* 22.9 (2001): 560-564.

12. Snyder GM., *et al*. "Detection of methicillin-resistant Staphylococcus aureus and vancomycin-resistant enterococci on the gowns and gloves of healthcare workers". *Infection Control and Hospital Epidemiology* 29.7 (2008): 583-589.

13. System NNIS, others. "National Nosocomial Infections Surveillance (NNIS) system report, data summary from January 1992 through June 2004, issued October 2004". *American Journal of Infection Control* 32.8 (2004): 470-485.

14. Chacko L., *et al*. "Survival of nosocomial bacteria on hospital fabrics". *Indian Journal of Medical Microbiology* 21.4 (2003): 291.

15. Pydi S., *et al*. "Microbial contamination of the white coats among preclinical and clinical dental students: A comparative cross-sectional study". *Journal of Indian Association of Public Health Dentistry* 13.2 (2015): 193-196.

16. Muhadi SA., *et al*. "A cross-sectional study of microbial contamination of medical students' white coat". *Malaysian Journal of Microbiology* 3 (2007): 35-38.

17. Fadila Noor and R Saraswati Jayanthi. "The study of microbial flora on doctors white coats in tertiary care hospital in outskirts of Hyderabad, Telangana, India". *International Journal of Research in Medical Sciences* 4.7 (2016): 2705-2712.

18. Josephat Qaday., *et al*. "Bacterial Contamination of Medical Doctors and Students White Coats at Kilimanjaro Christian Medical Centre, Moshi, Tanzania". *International Journal of Bacteriology* (2015): 507890.

19. Srinivasan M., *et al*. "The medical overcoat-is it a transmitting agent for bacterial pathogens?" *Japanese Journal of Infectious Diseases* 60.2-3 (2007): 121-122.

20. Fernandes E. "Doctors and medical students in India should stop wearing white coats". *British Medical Journal* 351 (2015): h3855.

21. R Robati., *et al*. "Effect of white coats on spread of nosocomial infection". *European Journal of Experimental Biology* 3.3 (2013): 156-159.

22. Landry M., *et al*. "Patient preferences for Doctor attire: the White Coat's place in the medical profession". *The Ochsner Journal* 13.3 (2013): 334-342.

23. Henderson J. "The endangered white coat". *Clinical Infectious Diseases* 50.7 (2010): 1073-1074.

24. LS Munoz-Price., *et al*. "Associations between bacterial contamination of healthcare workers' hands and contamination of white coats and scrubs". *American Journal of Infection Control* 40.9 (2012): e245-e248.

25. JC Cata˜no., *et al*. "Bacterial contamination of clothes and environmental items in a third level hospital in Colombia". *Interdisciplinary Perspectives on Infectious Diseases* (2012): 507640.

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