

**Original article:**

## White coat of health care professionals as potential reservoir of microbial flora and MRSA

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### ABSTRACT

**Background:** Contamination is a dynamic procedure including attack of body tissues by pathogenic smaller scale living beings and their poisons. Garments, medical attendants' garbs and other emergency clinic pieces of clothing, materials and articles may have a critical influence in transmitting pathogenic microbes in a hospital setting. Horizontal transmission of bacteria, especially multidrug-resistant organisms (MDROs), remains an important concern in hospitals worldwide. Microbial transmission from patient to patient has been linked to transient colonization of health care professional's attires. The World Health Organization (WHO) defines healthcare-associated infections (HAIs) as an infection occurring in a patient in a healthcare facility in which the infection was neither present nor in incubation period at the time of admission. This includes infections acquired in the hospital, but appearing after discharge, and also occupational infections among staff of the facility.

**Aim:** To study the prevalence of bacterial pathogens on white coat of health care professionals and to study the prevalence of Methicillin Resistant *Staphylococcus aureus*.

**Materials and Methods:** A total 200 samples were taken with moistened sterile swabs from 100 white coats belonging to healthcare professionals. Out of 100 white coats, 60 were belonging to the doctors from different grades and specialities and 40 were belonging to the nurses. Two samples were taken from two different sites of each white coat i.e. cuff and side pocket mouth. The sampled swabs were processed by standard microbiological methods.

**Results:** White coat belonging to nurses (92.50%) is more contaminated than those belonging to doctors (86.67%). Prevalence of microbial flora on white coats of healthcare professionals was 89%. The most commonly isolated microorganism was *Diphtheroids* (31.36%), followed by *Micrococcus* species (21.60%), *Bacillus* species (12.54%), Coagulase Negative Staphylococci (CONS) (12.20%), *Staphylococcus aureus* (11.15%), *Pseudomonas* species (4.53%), *Klebsiella* species (3.83%), *Enterobacter* species (1.74%), *Enterococcus* species (1.05%). Methicillin resistant *Staphylococcus aureus* (MRSA) was recovered from white coats of healthcare professionals were 14 out of 32 i.e., 43.75%, which could be a cause of concern. Fungal isolates from white coats of healthcare professionals were maximum *Aspergillus* species 65%, *Candida* species 25%, *Penicillium* species 10%.

**Conclusion:** In order to prevent transmission of infection, proper maintenance and handling practices of the white coats are precautions to be taken in order to minimize the degree of microbial contamination and to prevent cross contamination of healthcare-associated infections in hospital setting. A strict protocol should be set into play in order to prevent cross contamination between doctor and patient.

**Keywords:** White coats, healthcare professionals, infections, bacteria, fungi.

## **INTRODUCTION**

White coats play an important role to recognize a doctor or other health care workers (HCWs) in India and also in other countries, beside this it also protects their body from transmission of infectious agent, i.e. microbial pathogens during seeing the patient and handling the patient samples, however it also has a significant hazard for patients and their families visiting a health care facility, because the bacterial pathogens may harbour on it. [1-3]

Healthcare-associated infections (HAIs) involve many complex factors. One of the main factors is HCWs, i.e. Doctors, Nurses, Laboratory technicians and Attendants. They are directly or indirectly come in contact with blood, body fluids and other clinical samples. [4-6] Risk to HCWs acquiring micro-organisms through workplace exposures, HCWs who are already colonized with these microorganisms represent a risk to patients; studies have reported that 2-15% of HCWs are colonized or infected with MRSA. [7-12]

The World Health Organization (WHO) defines HAI as an infection occurring in a patient in a Healthcare facility in which the infection was not present or was incubated at the time of admission. This includes infections acquired in the hospital, but appearing after discharge, and also occupational infections among staff of the facility. [1-3] HAIs are a major public health problem worldwide. An estimated 1.4 million people worldwide suffer from infections acquired in hospitals at any point of time. [1,4] The infection transmitted from patients-to-patients within health care facilities has been associated with the lodging of pathogens in white coats of HCWs. HCWs hanging their white coats in their cars and offices or carrying them outside the hospital areas which is very common today and it increases the chances for the infection of MRSA which might be spread of hospital to the community and vice versa. [13] In the present study, we aim to find out the prevalence of bacterial pathogens including MRSA on white coats of HCWs. This study will be effective to enhance the knowledge and importance of white coats acting as a vector for transmitting HAIs to the patients and their family, relatives who visited.

## **MATERIALS AND METHODS**

This prospective and cross sectional study was conducted at Department of Microbiology, N.C. Medical College and Hospital, Israna, Panipat, Haryana, India, over a period of six months from July 2017 to December 2017. Approval from the institutional ethical committee was obtained before the start of the study. A total 200 samples were taken with moistened sterile swabs from 100 white coats belonging to healthcare professionals. Out of 100 white coats, 60 were belonging to the doctors from different grades and specialities and 40 were belonging to the nurses. Two samples were taken from two different sites of each white coat i.e. cuff and side pocket mouth. The nurses were additionally included in this study to provide for the purpose of comparison. The study was voluntary and one could choose not to participate. This was done to increase participation by keeping the data anonymous.

## **METHODOLOGY:**

### **Sample collection technique:**

1. The collection of samples from health care professionals white coats were performed by the technique of rolling a sterile swab moistened in sterile peptone water on the target site.

2. Samples from each white coat, the swab was taken from the cuff and side pocket mouth. These sites were chosen because they are known to harbour microorganisms in high concentration [14-17].

3. The samples were appropriately labelled and then transported to the laboratory for microbial analysis.

A self-administered questionnaire was used to collect demographic data and laundering habits regarding the white coat. Demographic variables included: gender, position, specialty, years of experience, reason for wearing white coats, number of white coats possessed and location of white coat usage. Usage in this study refers to when and where doctors wear the coat. [6,11] Laundering habits included: frequency of washing and washing agents used. This self-administered questionnaire was labelled with a number. The samples taken corresponded to the number on the questionnaire and an alphabet, "A" for cuff and "B" for pockets. This allowed for the data to be anonymous to ensure confidentiality.

#### **PROCEDURE:**

The swabs, which were used for collection of samples, were plain, cotton-tipped and sterilized swabs. 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 the swabs was sent immediately to the laboratory. The swabs, which were received in the Department of Microbiology, were immediately streaked onto blood agar and MacConkey's agar and the plates were incubated overnight at 37°C. The colonies which were obtain was identified by using standard techniques [18]

Methicillin resistance in *Staphylococcus* species were tested with the help of Cefoxitin disc (Hi-Media Ltd, Mumbai, India) on Mueller Hinton agar as per Central Laboratory Standard Institutional (CLSI) guidelines. [19]

**STUDY SITE:** The study was carried out in the Department of Microbiology, N. C. Medical College and Hospital, Panipat. Informed consent was obtained from all the participants.

#### **THE STUDY POPULATION:**

A total of 100 white coats were randomly sampled from doctors and nurses working in the hospital on the days of sampling.

#### **INCLUSION CRITERIA:**

1. Sample collected from doctors and nurses from department of Paediatrics, Medicine, Ophthalmology, ENT, Skin and STD, Surgery and Obstetrics and Gynaecology).
2. White coat worn for 3 consecutive days inside the department and not exchanged with others.
3. White coat which are not exchanged with other colleagues.

#### **EXCLUSION CRITERIA:**

1. White coat are worn outside the department and exchanged with others.
2. White coat exchanged with other colleagues.
3. Health care professionals who wore white coats but did not deal directly with patients or patient samples.

**STATISTICAL ANALYSIS:**

Statistical analysis was done using SPSS 16.0 v. Descriptive analysis was done to estimate the percentage of microorganisms and the Chi Square test was done to assess the difference in proportions. Level of significance was take at  $p < 0.05$ .

**RESULTS**

In present study total 200 samples were taken with moistened sterile swabs from 100 white coats belonging to healthcare professionals. Out of 100 white coats, 60 were belonging to the doctors from different grades and specialities and 40 were belonging to the nurses. Two samples were taken from two different sites of each white coat i.e. cuff and side pocket mouth. Out of 60 doctor’s white coats 52 found to be contaminated and 8 were sterile. In nurses out of 40 white coats, 37 were contaminated and 3 were sterile. White coat belonging to nurses (92.50%) is more contaminated than those belonging to doctors (86.67%) however, this difference is not statistically significant (Chi-square = 0.834, degrees of freedom =1, p value = 0.361, statistically not significant. [Table 1]

Table 1: Contamination of white coat used by health care professionals.

Health Care Professionals	White coats		
	Contaminated	Sterile	% of contamination
Doctors (n=60)	52	8	86.67
Nurses (n=40)	37	3	92.50
Chi-square = 0.834, degrees of freedom =1, p value = 0.361			

Out of 100 white coats 89 were found to be contaminated and 11 white coats were sterile. Prevalence of microbial flora on white coats of healthcare professionals were 89%. [Table 2]

Table 2: Prevalence of microbial flora on white coats of health care professionals.

Total no. of samples	Positive	Negative	Percentages
100	89	11	89%

Risks to healthcare professionals (HCPs) acquiring micro-organisms through workplace exposures, HCPs who are already colonized with these microorganisms represent a risk to patients, contamination of white coats used by doctors from different speciality i.e. maximum were in microbiology 100% followed by medicine 92.31%, surgery 91.67%, Obstetrics and Gynaecology 87.50%, orthopaedics 85.71%, paediatrics 80%, ophthalmology and dentistry 66.67% each and ENT 50%. [Table 3]

Table 3: Contamination of white coat used by doctors.

Department	No. of white coat examined	White coat contaminated	
		No.	%
Medicine	13	12	92.31
Surgery	12	11	91.67
Obstetrics and Gynaecology	8	7	87.50
Paediatrics	5	4	80
Orthopaedics	7	6	85.71
ENT	2	1	50
Ophthalmology	3	2	66.67
Microbiology	7	7	100
Dentistry	3	2	66.67
Total	60	52	86.67

Contamination of white coat used by nurses in different wards i.e. medicine, surgery, Obstetrics and Gynaecology, Orthopaedics and Ophthalmology 100% each followed by paediatrics 83.33%, ENT 75% and dentistry 66.67% [Table 4]

Table 4: Contamination of white coat used by nurses.

Department	No. of white coat examined	White coat contaminated	
		No.	%
Medicine	7	7	100
Surgery	6	6	100
Obstetrics and Gynaecology	7	7	100
Paediatrics	6	5	83.33
Orthopaedics	5	5	100
ENT	4	3	75
Ophthalmology	2	2	100
Dentistry	3	2	66.67
Total	40	37	92.50

Types of microbial contamination from white coat of doctors were single type bacteria 51.92%, two or more type bacteria 38.46%, bacteria and fungi 7.69% and only fungi 1.92%. In nurses white coats single type of bacteria 24.32%, two or more type of bacteria 51.35%, bacteria and fungi 13.51% and only fungi 10.81%. [Table 5]

Table 5: Types of microbial contamination from white coat of healthcare professionals.

Types of microbial contamination	Doctors (n=60)		Nurses (n=40)		Total (n=100)	
	No.	%	No.	%	No.	%
Single type of bacteria	27	51.92	9	24.32	36	40.45
Two or more type of bacteria	20	38.46	19	51.35	39	43.82
Only fungi	1	1.92	4	10.81	5	5.62
Bacteria and fungi	4	7.69	5	13.51	9	10.11
Total	52	100	37	100	89	100

Total 287 bacteria were isolated, comprising of 9 species. Of which 258/287 (89.90%) were Gram-positive bacteria and 29/287 (10.10%) were Gram negative bacteria. The most commonly isolated organism was *Diphtheroids* 31.36%, followed by *Micrococcus* species 21.60%, *Bacillus* species 12.54%, Coagulase Negative Staphylococci (CONS) 12.20%, *Staphylococcus aureus* 11.15%, *Pseudomonas* species 4.53%, *Klebsiella* species 3.83%, *Enterobacter* species 1.74%, *Enterococcus* species 1.05%. [Table 6] 22.30% (83/136) white coats sampled, presented with bacteria that are established nosocomial pathogens such as *S. aureus*, *Enterococci*, *Pseudomonas*, *Enterobacter*, and *Klebsiella* species.

Table 6: Bacterial isolates from white coats of healthcare professionals.

Bacterial isolates from white coats	Doctors (n=60)		Nurses (n=40)		Total (n=100)	
	No.	%	No.	%	No.	%
<i>Staphylococcus aureus</i>	20	10.87	12	11.65	32	11.15
Coagulase Negative Staphylococci (CONS)	22	11.96	13	12.62	35	12.20
<i>Bacillus</i> species	21	11.41	15	14.56	36	12.54
<i>Micrococcus</i> species	41	22.28	21	20.39	62	21.60
<i>Diphtheroids</i>	58	31.52	32	31.07	90	31.36
<i>Psuedomonas</i> species	8	4.35	5	4.85	13	4.53
<i>Klebsiella</i> species	7	3.80	4	3.88	11	3.83
<i>Enterobacter</i> species	4	2.17	1	0.97	5	1.74
<i>Enterococci</i> species	3	1.63	0	0	3	1.05
Total	184	100	103	100	287	100

MRSA was recovered from white coats of healthcare professionals were 14 out of 32 i.e., 43.75%, which could be a cause of concern [Table 7].

Table 7: Methicillin resistant *Staphylococcus aureus* from the white coats of healthcare professionals.

Healthcare Professionals	Methicillin Resistant <i>Staphylococcus aureus</i>		Methicillin Sensitive <i>Staphylococcus aureus</i>	
	No.	%	No.	%
Doctors	9	64.29	11	61.11
Nurses	5	35.71	7	38.89
Total	14	100	18	100

Fungal isolates from white coats of healthcare professionals were maximum *Aspergillus* species 65%, *Candida* species 25%, *Penicillium* species 10%. Doctors white coats were contaminated with *Aspergillus* species i.e., 72.73%, followed by *Candida* species 27.27%. Nurses white coats were more contaminated with *Aspergillus* species 55.56%, followed by *Candida* species and *Penicillium* species 22.22% each [Table 8]

Table 8: Fungal isolates from white coats of healthcare professionals.

Fungal isolates from white coats	Doctors (n=60)		Nurses (n=40)		Total (n=100)	
	No.	%	No.	%	No.	%
<i>Aspergillus</i> species	8	72.73	5	55.56	13	65
<i>Candida</i> species	3	27.27	2	22.22	5	25
<i>Penicillium</i> species	0	0	2	22.22	2	10
Total	11	100	9	100	20	100

Male doctors were 36 (60%) and female doctors 24 (40%). Male nurses were 8 (20%) and female nurses 32 (80%). The responses of doctors to the question reason to wear white coat, maximum were responses i.e. To appear professional 55%, followed by Dress code of hospital 20%, Identification 8.33%, For usage of pockets, To cover clothing and Protect form infection 5% each. However nurses response maximum to Dress code of hospital 40% followed by To appear professional 22.50%, To cover clothing and For usage of pockets 12.50% each, To keep warm 7.50%, Identification 5% and no response against Protect form infection. Most selected location of white coat use by doctors and patients interaction 40%, however; meeting with seniors 18.33% is the second most commonly selected option, which indicates the use of white coat in non-clinical areas as well as use outside the hospital, then hospital area 15%, always and official gathering 13.33% each. However nurses response were coat use is hospital area 32.50%, meeting with seniors 25% is the second most commonly selected option, then patient interaction 22.50%, official gathering 12.50% and always 7.50%. Frequency of washing white coat answered by doctors were maximum Less than 3 days 38.33%, followed by 1 week 31.67%, 2 to 4 weeks 18.33% and more than 1 month 11.67%. Nurses answered were maximum Less than 3 days 15%, followed by one week 42.50%, 2 to 4 weeks 27.50% and more than 1 month 15%. Washing agents used by doctors maximum were soap 60%, liquid wash 31.67% and disinfectants 8.33%. However nurses used soap 70% and liquid wash 30%. Responses to the question can white coat play a role in transmission of infections by doctors 36.67% and nurses 12.50%. [Table 9]

Table 9. Knowledge, attitude and behaviour of health care professionals to using white coats.

Characters	No. of doctors (n=60)		No. of Nurses (N=40)	
	No.	%	No.	%
<b>Gender</b>				
Male	36	60	8	20
Female	24	40	32	80
<b>The reason to wear white coat</b>				
To cover clothing	3	5	5	12.50
To keep warm	1	1.67	3	7.50
To appear professional	33	55	9	22.50
Dress code of hospital	12	20	16	40.00
For usage of pockets	3	5	5	12.50
Identification	5	8.33	2	5
Protect form infection	3	5	0	0
Any other	0	0	0	0
<b>Location of white coat</b>				
Patient interaction	24	40	9	22.50
Hospital area	9	15	13	32.50
Always	8	13.33	3	7.50
Meeting with seniors	11	18.33	10	25
Official gathering	8	13.33	5	12.50
<b>Frequency of washing</b>				
<3 days	23	38.33	6	15
1 week	19	31.67	17	42.50
2-4 week	11	18.33	11	27.50
>1 month	7	11.67	6	15
<b>Washing agents</b>				
Soap	36	60	28	70
Liquid wash	19	31.67	12	30
Disinfectants	5	8.33	0	0
<b>Can white coat play a role in transmission of infection</b>				
Yes	22	36.67	5	12.50
No	38	63.33	35	87.50



## DISCUSSION

White coats might be considered as an image of the restorative calling, bringing it validity and are thought to imply virtue. In any case, they have been shown to harbour microorganisms and may perhaps transmit contaminations. The white coat can get debased by microorganisms because of ill-advised dealing with practices. They get effectively debased on the grounds that patients persistently shed irresistible microorganisms in the emergency clinic condition, and the social insurance suppliers are in consistent contact with these patients. Staphylococci are the pathogens having a place with the gathering of *Enterobacter* microscopic organisms, which cause a few contaminations to people. They are facultative anaerobic gram-negative cocci for the most part found in the skin and mucosa and are of three kinds *Staphylococcus aureus*, *Staphylococcus epidermidis* and *Staphylococcus haemolyticus* [20]. Medicinal services experts are most vulnerable to colonization, and the primary type of transmission is through incidentally colonized hands. Critically, treatment of diseases brought about by *S. aureus* has turned out to be troublesome on account of their higher protection from different medications [21].

*S. aureus* is a piece of the ordinary human microbial vegetation and it is found in the nasal sections, throat, gastrointestinal tract and skin. It is considered as a standout amongst the most imperative pathogenic microorganisms, causing arrangement of diseases [22, 23] prompting the development of abscesses. It causes diseases, for example, furuncles, folliculitis, burnt skin disorder, meningitis, and pneumonia. Coagulase-negative staphylococci (CONS) which is a skin commensal has as of late got consideration as a potential pathogen, explicitly for nosocomial diseases [17, 24, 25]. CONS are a noteworthy reason for nosocomial disease and septicemia, particularly in instances of safe bargained patients [26].

This investigation assessed the sort of microbial verdure present on the white coat of the clinicians working in the tertiary care hospital. Two samples were taken one from cuff and another side pocket mouth for detection of microbial contamination. Microbial contamination was believed to be most elevated as these locales most ordinarily interacts with the patients [27, 28]. This think about demonstrated that the quantities of gram positive cocci was equivalent to that of different investigations and limit of them were possibly pathogenic [28, 29]. This is reliable with different examinations that indicated defilement of garments running from 23% to 95% [30]. They have a danger of cross pollution if the host is invulnerable traded off. Micrococci may go about as a crafty pathogen in patients with traded off invulnerable frameworks and they most ordinarily cause circulation system disease. Gram negative bacilli were additionally disengaged, however these were fundamentally lesser in number and they might be conceivably irresistible, as was accounted for by Zachary and Grabsch. They have appeared bacterial survival rate is of longer timeframe on emergency clinic fabrics [31, 32]. Chacko et al. have appeared on garment textures made up of either cotton polyester or polyester material, microbes can make due between 10-98 days. Thus the white coat thought to be washed every day or possibly once in 3 days [33]. Of the two foreordained locales chose for examination on the garment, the mouth of the overwhelming pocket was more debased than the chest and sleeves of the sleeve. This is like the investigation of Nelly and in spite of that of Uneke and Ijeoma which demonstrated that sleeve has more bacterial burden than the pocket [1]. Pocket is the profoundly defiled region since it much of the time interacts with the hands of the social insurance experts harboring bacterial contaminants.

## CONCLUSION

The present study features the way that the white coats may go about as a vector for transmission of cross disease. So as to counteract transmission of cross disease, an exacting convention ought to be set so as to forestall cross contamination among specialist and patient. Efforts should be made to restrain the utilization of white coats outside the working zone and they should be washed each day. Wearing of plastic covers or modifying garment material to plastic-overlaid dress or firmly woven waterproof cotton can diminish the bacterial exchange rate and cross-contamination. An absence of hand cleanliness without a doubt upgrades the tainting of the white coats, since they are frequently contacted by the doctors over the span of their work. Thus, there is a squeezing need to advance a conscientious hand washing among the doctors when they took care of patients and furthermore to elevate options in contrast to the white coats, which incorporates the all inclusive utilization of defensive outfits.

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