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Research Article

White coats: how much safe are they?

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ABSTRACT

Background: Various studies have suggested that health care workers'(HCW) clothing, including white coats, are potential reservoirs for microorganisms causing health care associated infections, reinfecting the hands of HCWs and may be a vector for transmission of nosocomial pathogens. Hence the present study was undertaken to detect the incidence of pathogenic microorganisms that contaminate nurses white coats.
Methods: Total 324 swabs, collected by swabbing the three sites of the surface of the Nurses' white coat (pockets, abdominal zone and the sleeve ends) were inoculated on blood agar, Mac-Conkey's agar and incubated at 37°C overnight. Microbial growth was identified by standard methods. Antibiotic sensitivity test was carried out by Kirby-Baur disc diffusion method as per CLSI guidelines.
Results: Non-pathogenic bacteria (skin flora) were isolated from all white coat culture and pathogenic bacteria from 76 (70.3%) white coats (45 from Surgery & allied departments, 31 from Medicine & allied departments). From total 324 samples, 85 (26.2%) samples were positive for pathogenic bacteria and total 94 pathogenic bacteria were isolated which includes 33 (35.1%) Staphylococcus aureus (6 MRSA, 27 MSSA), 56 gram negative bacilli (17 ESBL producers). The rate of contamination with pathogens, was higher on pockets (57.4%) compared with abdominal zone (27.6%) and sleeve ends (14.8%).
Conclusions: The study highlights the importance of white coats as potential source of cross infection. A strict protocol should be followed for preventing cross-contamination from the white coats.

Keywords: Health care associated infections, Nursing staffs, White coat

INTRODUCTION

Health care associated Infections are on the rise worldwide. Microorganisms are most commonly transmitted by the hands of healthcare personnel but materials and articles used in the hospitals could also carry microorganisms.[1]

Various studies have suggested that health care workers' clothing, including white coats, are potential reservoirs for hospital organisms which reinfect the Hands of Health Care Workers (HCWs) and may act as vector for transmission of nosocomial pathogens.[2-5]

In medical profession, the main purpose of wearing white coat is for protection against cross-contamination and also it connotes life, purity, innocence and goodness.[6,7] But studies have shown that these coats may actually play a role in transmitting pathogenic microorganisms in a hospital setting.[3,4,8-10] Contamination of white coats with important nosocomial pathogens, such as Methicillin-Sensitive Staphylococcus aureus (MSSA), Methicillin-Resistant Staphylococcus aureus (MRSA), Vancomycin-Resistant Enterococci (VRE) and gram negative organisms is well documented.[4,5,11,12]

No studies have reported direct evidence of transmission of microorganisms from white coats to patients. HCWs'

attitudes to white-coat usage, frequency of washing of white coat and handling could influence potential of these coats to transmit nosocomial infections. Hence present study was undertaken to detect incidence of pathogenic organisms that contaminate nurses' white coats.

METHODS

This cross sectional study was conducted in a rural tertiary care hospital and department of microbiology. The project was approved by institutional ethics committee. 108 on duty nursing staffs who volunteered for participation in the study were included. Out of these 108 nursing staffs, 42 were from Medicine and allied departments and 66 were from Surgery and allied departments. A self-administered questionnaire about white coat usage was given to nursing staffs. Total number of 324 swabs (sterile swabs moistened with sterile saline) were collected by swabbing the three sites of the surface of the white coat (pocket, abdominal zone and the sleeve ends). All swabs were inoculated on blood agar and Mac-Conkey's agar and incubated at 37°C overnight and examined for microbial growth. The microorganisms were identified by standard methods.[13] The recovered bacteria were classified into two groups: 1) Non-pathogenic skin flora which includes coagulase negative Staphylococcus (CONS), Bacillus species, Micrococcus species, Diphtheroides and 2) Pathogenic bacteria i.e. Staphylococcus aureus, Enterobacteriaceae, Pseudomonas aeruginosa, Acinetobacter species etc. Antibiotic sensitivity test was carried out by Kirby-Baur disc diffusion method as per CLSI guidelines.[14] Detection of Methicillin Resistant Staphylococcus aureus (MRSA) using cefoxitin disc 30 µg and ESBL producing organisms by combined disc method (Ceftazidime 30 µg and cefdazidime + clavulanic acid disc 30 µg/10 µg) were carried out.[14] For detection of HLAR (High level aminoglycoside resistant Enterococci). High level gentamicin disc 120 µg and for Vancomycin Resistant Enterococci (VRE), VRE agar having vancomycin 6 µg/ml was used as per CLSI guidelines.[14]

RESULTS

Total 324 samples were obtained from 108 nursing staffs working in Surgery and allied departments (66) and Medicine and allied departments (42) in our tertiary care hospital. Nonpathogenic bacteria which are usually considered as skin flora was isolated from all white coat culture and pathogenic bacteria were isolated from 76 (70.3%) white coats. Growth of microorganisms was in the range of 10-40 colonies per sample in all 76 white coats. Out of these 76 white coats, 45 (59.2%) were from Surgery and allied departments and 31 (40.7%) were from medicine and allied departments (Figure 1). Pathogenic bacteria were isolated from one site in 69 (63.8%) white coats, from two sites in 5 (4.6%) white coats and from all three sites in 2 (1.8%) white coats i.e. from total 324 samples, 85 (26.2%) samples were positive for pathogenic bacteria (Table 1).

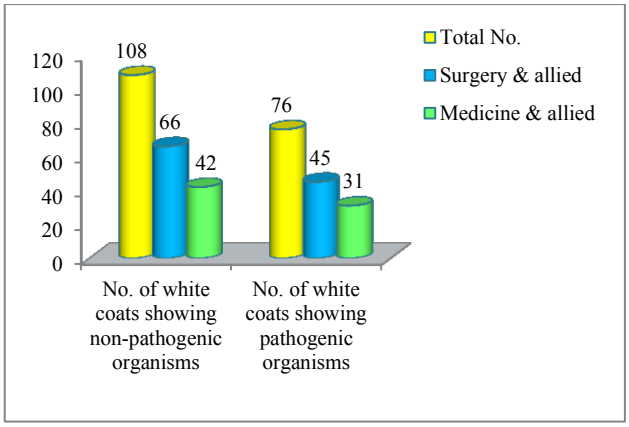

Figure 1: Department wise distribution of white coats showing pathogenic and nonpathogenic organisms.

Table 1: Isolation of pathogenic bacteria from different sites.

Site	Number of white coats (n=108)	Number of samples (n=324)
One site	69 (63.8%)	69 (21.2%)
Two sites	5 (4.6%)	10 (3.0%)
Three sites	2 (1.8%)	06 (1.8%)
Total	76 (70.3%)	85 (26.2%)

Out of 85 samples showing growth of pathogenic bacteria, 77 (90.5%) samples showed growth of single type of bacteria while 7 (8.2%) showed growth of two types of bacteria and 1 (1.1%) sample showed growth of 3 types of bacteria i.e. total 94 pathogenic bacteria were isolated (Table 2). Out of these 94 pathogenic isolates, 54 (57.4%) isolates were from pockets (Surgery & allied 33, medicine & allied 21), 26 (27.6%) isolates were from abdominal zone (Surgery& allied 15, medicine & allied 11) and 14 (14.8%) isolates were from sleeve ends (Surgery & allied 8, medicine & allied 6). So out of total 94 pathogenic bacteria isolated, 56 (59.5%) isolates were from surgery & allied departments while 38 (40.4%) isolates were from Medicine and allied departments (Figure 2).

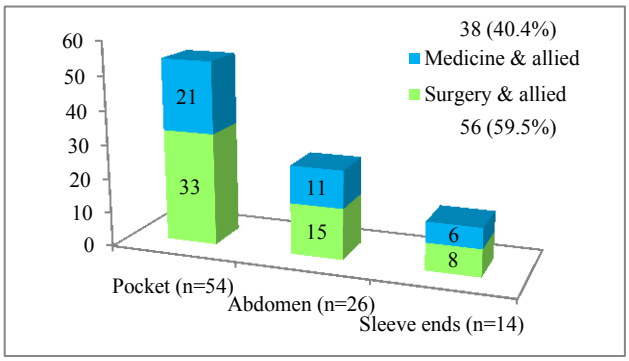

Figure 2: Pathogenic bacteria (n=94) isolated from various sites and departments.

Table 2: Isolation of pathogenic bacteria (N=94) from samples (n=85).

Growth of organism	Number of samples	Number of pathogenic bacteria
One type	77 (90.5%)	77
Two type	7 (8.2%)	14
Three type	1 (1.1%)	3
Total	85	94

Amongst 94 pathogenic bacteria, 33 (35.1%) Staphylococcus aureus were isolated of which 6 were MRSA and 27 were MSSA. Out of 56 Gram negative bacilli isolated, 18 (32.1%) were ESBL producers (Klebsiella pnumoniae 7, E. coli 6, P. aeruginosa 3, Acinetobacter 2) but no Carbapenem Resistant Enterobacteriaceae (CRE) or Carbapenemase producing gram negative bacilli were isolated. 05 (5.3%) Enterococcus faecalis were isolated and 2 of them were High Level Aminoglycoside Resistant (HLAR) (Figure 3). No Vancomycin Resistant Enterococci (VRE) or Vancomycin Resistant Staphylococcus aureus (VRSA) was detected in the present study.

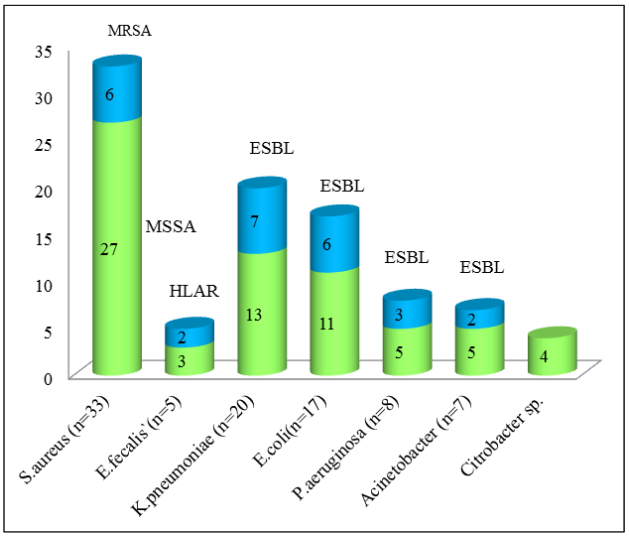

Figure 3: Bar diagram showing pathogenic bacteria isolated (n=94) from white coats of nursing staff.

Questionnaire survey regarding white coat usage revealed that out of 108 nursing staffs, 48 (44.4%) nursing staffs were aware of the white coat as a potential agent in the transmission of microbes, 16 (14.8%) exchanged white coats with colleagues, 87 (80.5%) carried their white coats back home and 21 (19.4%) left their white coats at hospitals.

Regarding frequency of white coat washing by nursing staffs, 26 (24%) washed their white coat daily, 38 (35.1%) within 2 days, 24 (22.2%) within 3 days and 20 (18.5%) after 4-7 days respectively (Table 3).

From 26 white coats washed daily, 6 white coats show growth of pathogenic bacteria with colony count ranging from 10-12 while from 20 white coats washed after 4-7 days interval, 12 white coats showed growth of pathogenic bacteria with colony count ranging from 25-40.

Table 3: Questionnaire regarding white coat usage by nursing staffs (n=108).

Items	Numbers	Percentage (%)
Aware of white coat as a potential agent in transmission of microbes	48	44.4
Exchanged white coats with colleagues	16	14.8
Carried their white coats back home	87	80.5
Left their white coats at hospitals	21	19.4
Frequency of white coat washing		
1 day	26	24
2 days	38	35.1
3 days	24	22.2
4-7 days	20	18.5

DISCUSSION

Various studies have found contamination of HCWs, clothing during patient care activities and transmission of bacteria through uniforms and white coats. These contaminated clothing act as a reservoir hence even after proper hand hygiene procedures, the hands of HCWs may get recontaminated allowing transmission of pathogens to patients or the environment.[3,8,15] In the present study, 70.3% of white coats were found to be contaminated with pathogenic bacteria. This is consistent with other studies that showed contamination of white coat ranging from 23% to 95%.[3,4,9,11] The infectious microorganisms are continuously shed in the hospital environment and nurses are in constant contact with these patients. Studies have shown that on hospital fabrics bacteria survive for longer periods. Staphylococci and Enterococci survive for over 90 days and Gram negative bacteria for over 60 days.[16,17] Another study by Chacko et al.[2] 2003 have shown that microorganisms can survive between 10-98 days on fabrics used for white coats including cotton, cotton and polyester or polyester materials. Hence the white coats should be washed daily or at least once in 3 days. In the present study high incidence of contaminated uniforms might be related to inadequate compliance with hand hygiene. Also the sampled sites (pockets, abdominal zones, sleeve ends) are characterized by frequent touches and microbial contamination had been reported to be greatest in concentration at these sites.[3,8]

In the present study, percentage of contaminated white coats and percentage of pathogenic isolates from surgery & allied departments were 59.2% and 59.5% respectively whereas from medicine & allied departments they were

40.7% and 40.4% respectively. In study by Srinivasan et al.,[9] percentage of contaminated white coats from Surgery and medicine departments was 100% and 87% respectively whereas Wiener-Well et al.[11] reported the rate of contamination of physicians and nurses attire from medicine ward 55% and from surgery ward 46%.

In this study, the rate of contamination with pathogens was higher on pockets (57.4%) compared with abdominal zone (27.6%) and sleeve ends (14.8%).This may be related to frequent contact of pockets with contaminated hands and other contaminated materials kept in pockets. In study by Wiener-Well et al.,[11] the rate of contamination with pathogens was similar on abdominal zone and pockets (50%) as compared to sleeve ends (48%).

In the present study, one or more non-pathogenic skin flora i.e. CONS, Bacillus species, Micrococcus species, Diphtheroides were isolated from all white coat cultures. Though these microorganisms are skin commensals, they have also been implicated as causative agents of nosocomial infections.[8,11]

In this study, gram negative bacilli and gram positive bacilli were isolated from white coats. This is consistent with spectrum of bacterial isolates from other similar investigations.[3,9,11] Amongst gram negative bacilli, Klebsiella pneumoniae and E. coli were the predominant organisms. Amongst gram-positive cocci, Staphylococcus aureus (35.1%) was the predominant organism. This remains consistent with other studies.[4,8]

Out of 94 pathogenic bacteria isolated, 26 (27.6%) were drug resistant organisms (6 MRSA, 18 ESBL producing Gram negative organisms and 2 HLAR Enterococci) which is a cause of concern. In study by Treakle et al.,[4] 18% white coats were contaminated with MRSA while Wiener-Well et al.[11] reported that 11% organisms in their study were multidrug resistant.

Questionnaire regarding white coat usage revealed that 44.4% nursing staffs were aware of white coat as a potential agent in the transmission of microbes. 80.5% nursing staffs carried their white coats back home. So there could be a risk of transmission of these hospital acquired drug resistant microbes in the community. The intervals at which the coats were washed were not included as a study parameter as it has been emphasized in literature that the coats become contaminated quickly once worn and there appears to be little difference between the colony counts according to the frequency of laundering.[8] In the present study, the colony count and isolation of pathogenic bacteria including MRSA & ESBL was more who washed coats at the interval of 4-7 days compared to those who washed their coats per day. This observation varied with the reports from western countries may be because of their cold climate and ours is a tropical country. Also difference in finding may be because of various other factors such as strict maintenance of standard of hygiene, also the protocols for prevention of Hospital Acquired Infections are strictly followed in western countries as compared to developing countries. Moreover white coats in this study were hand washed. There is a scope for future study in this perspective.

Wong et al.[3] in their research paper on the microbial flora on doctors' white coats commented that the microbial counts do not vary with "time in use" of the white coat and a steady state of maximal microbial contamination is attained within the first week of use and does not change significantly thereafter. In the present study, we also got the steady state of maximal microbial contamination within the first week of use. In this study, as the white coats were washed within 7 days we couldn't see whether the contamination with organisms increases or didn't change significantly thereafter.

There are certain limitations for this study. First, only on duty nursing staffs who volunteered for participation in the study were included. A study including all nursing staffs from all departments at a time could have been more representative. Second, there was no control group (freshly laundered non worn white coats) in this study. Thus possibility of white coats being contaminated prior to their use could not be ruled out.

CONCLUSION

This study highlights the importance of white coats as potential source of cross infection. Efforts should be made to limit the use of white coats and they should be laundered frequently. Wearing of plastic aprons or altering white coat material to a plastic-laminated clothing or a closely woven waterproof cotton can reduce the bacterial transfer rate and cross-contamination.[15,18] A strict protocol should be followed for preventing cross-contamination from the white coats.

Recommendations[19,20]

1) Bare below the elbows policy defined as wearing of short sleeves white coat or uniform and no wristwatch, jewellery or ties during clinical practice.

2) Institutions where use of a white coat is mandatory for professional appearance HCWs should remove white coat before contact with patients or a patient's immediate environment.

3) Laundering:

a. Health Care Workers (HCWs) should have two or more white coats available and there should be a convenient and economical means to launder white coats.

b. Frequency: any clothes worn that come into contact with the patient or patient's environment should be laundered after daily use.

c. Hand washed clothing items is ineffective and unacceptable.

d. Home laundering:

*Hot water wash cycle ideally with bleach (10 minute wash at 60°C remove almost all micro-organisms) followed by a cycle in the dryer or ironing. (The extra heat encourages further thermal disinfection)

*Heavily soiled white coats should be washed separately (It will eliminate cross contamination and enable washing at the highest recommended temperature for the fabric.)

*White coats washed at home should not be transported in the same bag.

4) Use of white coat during travel, in canteens, hostel rooms or homes should be prohibited.

5) White coat should be left at hospital.

6) Proper hand hygiene practices must be followed.

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