

White coat of Interns as a fomite for microbes at a Tertiary care Hospital in Puducherry –A Cross-Sectional study

Madhumadhi S¹, Sushmita Sana Chowdhary², Gayathri S³, Janani S⁴,
Vedapriya Dande Rajasekar⁵

¹Department of Community Medicine, Sri Venkateswara Medical College Hospital & Research Centre, Ariyur, Puducherry

²Department of Microbiology, Sri Venkateswara Medical College Hospital & Research Centre, Ariyur, Puducherry

³Department of Anaesthesiology, Sri Venkateswara Medical College Hospital & Research Centre, Ariyur, Puducherry

⁴Department of Community Medicine, Sri Venkateswara Medical College Hospital & Research Centre, Ariyur, Puducherry

⁵Department of Community Medicine, Chettinad Hospital and Research Institute, Chettinad Academy of Research and Education, Kelambakkam, Tamil Nadu, India

*Corresponding author: Dr. Madhumadhi S, madhumadhi@svmchrc.ac.in

ABSTRACT

Background: White coats used by health care professionals are known to harbour microorganisms; and also, can act as a fomite in transmitting microbes. Hence, this study was conducted to determine the perception of microbial contamination, usage and handling practices of white coats among interns, prevalence of microbial contamination of white coats among them and also to find their association between various socio-demographic variables. **Methods:** This cross-sectional study was conducted among 141 Medical Interns of a Tertiary Medical College in Puducherry. A semi-structured questionnaire was used to assess their perception of microbial contamination of coats, usage and handling practices. Following which three swab samples were obtained from their coat pockets and abdominal area and was sent to Microbiology Department for determining the organisms.

Results: Mean \pm SD age of the participants was 23.4 ± 1.2 years and majority of them were females. Prevalence of microbial contamination of the coats was 95% with *E. coli* being the most commonly isolated organisms 75(27%). Right pocket area was found to be the main contaminated site 77(27.7%). More than half 80(56.7%) of the participants had poor coat handling practice and there was a statistically significant association between prevalence and the number of white coats possessed ($p=0.030$), practice of wearing it during work ($p=0.014$), the reason for wearing them ($p=0.030$) and between area of residence and good practice. **Conclusion:** The microbial contamination of white coats was high among medical interns, indicating their potential role as fomites. Interns had a poor coat handling practices and it was significantly associated with contamination. Thus, there is an urgent need to strengthen the infection control measures, promote appropriate coat usage and regular laundering reduce the risk of cross-infection in healthcare settings.

Keywords: White coats, Interns, Microbial contamination, Coat handling practices, Fomite

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INTRODUCTION:

The white coat is regarded as a symbol of the medical profession, serving as a means of identification, a marker of authority and a source of credibility for the field. (1-3) The white coat ceremony has become a tradition in numerous medical colleges to introduce the medical students to the field of medicine, symbolizing their transition into the profession while embracing humanistic values. (4-6) The additional perceived benefits of using a white coat are that, it was considered to instil confidence and also improves doctor-patient communication. (4)

Despite being seen as a symbol of cleanliness, white coat can serve as a fomite, promoting the spread of hospital-acquired illnesses. It may become contaminated with a variety of germs, primarily antibiotic-resistant ones like Methicillin-Resistant *Staphylococcus aureus* (MRSA), which can spread to patients and raise mortality. Additionally, it puts patients and their families at serious risk when they visit medical institutions. (7,8)

Traditionally white coats were worn during patient interactions and during clinical rounds inside hospital premises, but in recent

times it is worn not only during patient interactions but also in non-clinical areas also. It is quite common for healthcare workers and students to wear white coats outside of clinical areas, such as in canteens, supermarkets, libraries, public transport and even restrooms. Medical students often hang their coats in vehicles or carry them frequently outside of hospital premises, meaning these contaminated coats can serve as fomites, contributing to the ongoing spread of bacteria. (9-11) Infections transmitted between patients within healthcare facilities have been linked to the temporary presence of pathogens on the clothing, mobile phones, pens, watches of healthcare workers and students, including white coats, so when they go outside and comes in contact with the community, it poses a threat to spread of pathogens from hospital setting to the general public. Hence, the present study was planned to assess Interns perception of microbial contamination, usage and handling practices of white coats, prevalence of microbial contamination of white coats and also to find their association between various socio-demographic variables among them.

MATERIALS AND METHODS:

This cross-sectional study was carried out among 141 interns at a tertiary care hospital in Puducherry after receiving approval from the Scientific Research Committee and Institutional Ethics Committee [No: 29/ SVMCH/IEC – Cert/Aug22]. Yamens's formula was used to determine the sample size, during the study period a total of 168 interns were working which is the known population, with 95% confidence interval, 5% margin of error and the minimum expected sample size calculated was 117. Convenience sampling was used to include the participants and finally 141 interns had participated in the study. Every intern who agreed to take part was included, while those who had cleaned their coats the day before the data collection were excluded.

A semi-structured validated self-administered questionnaire in English was used for data collection. The questionnaire was developed from different literatures which has three parts i.e., baseline Sociodemographic information, perception towards white coat and its possible contamination, white-coat usage/handling practices and its reasons. (1,12) After completion of self-administered questionnaire, swab sample was collected from the participant's white coat from 3 sites – mouths of coat pocket (Right and Left) and from abdominal area. Before taking swabs both hands of laboratory technician were cleaned using an alcohol-based instant hand sanitizer, and powder-free disposable gloves was worn throughout the work to prevent cross-contamination. Three Plain, cotton tipped sterilized swabs moistened with normal saline was used for collecting samples from the specified sites of the coat. Samples collected were labeled appropriately and transported to the Microbiology Laboratory. At the laboratory the swabs were inoculated onto Blood agar and McConkey's agar which were incubated at 37°C for 24 hours under aerobic conditions for determining the microbial agents. Each participant's agar plate was divided into 3 parts for smearing the corresponding 3 swabs. The plates were examined for total microbial count. Plates after 48 hours showing no growth were considered negative. The bacteria and fungi grown were identified and examined using standard procedure. Data collection and subsequent swab collection was preferably done in mid-week (Wednesday/Thursday) at the Microbiology Department.

STATISTICAL ANALYSIS:

Data collected was entered in Microsoft Excel and analyzed using licensed Statistical Package for Social Sciences (SPSS) v.23.0 (IBM Corp., Armonk, N.Y., USA). The data was summarized and presented in the form of tables and appropriate figures. Sociodemographic data such as age was represented in Mean and Standard Deviation. Categorical variables such as gender, prevalence of microbial contaminants of white coat, their usage and handling practices were represented as percentages and proportions. Chi-Square test was done to find the association between prevalence of microbial contamination and socio-demographic variables and also between coat handling practices.

RESULTS:

The study included 141 interns among them, 58 (41.1%) were males and 83 (58.9%) were females and their Mean \pm SD age was 23.4 \pm 1.2 years. With regard to their area of residence, 71 participants (50.4%) resided inside the campus and 70 (49.6%) had stayed off-campus. In terms of the duration since the start of internship, 21 participants (14.9%) had started their internship within a month, 47 (33.3%) had completed 1–6 months, 72 (51.1%) had completed 7–12 months and only 1 participant (0.7%) had been in internship for more than 12 months. The majority of respondents thus had internship experience between 7 to 12 months.

Around 134 interns' white coats were contaminated contributing to a prevalence rate of 95%. Total of 423 swab samples were taken and microbial growth was observed in 277(65%) of samples. The isolates from the participants' white coats are shown in Figure 1. The most common organisms isolated were *E. coli* 75(27%) followed by *S. aureus* 61(22%) and Klebsiella,

P. aeruginosa accounting for 56(20%) each. More than 20 colony forming units were seen in the right pocket area 77(27.7%), followed by abdominal area 60(21.6%) and left pocket accounts for about 42(15.1%). Right pocket is the most contaminated site accounting for 77(54.6%) of gram-negative organisms. Gram positive organisms were majorly isolated from abdomen area of the white coats 37(26.2%). [Table 1]

Table 1: Frequency distribution of the white coats showing growth of microorganisms

Gram staining	Site n(%)	Site n(%)	Site n(%)
	Right pocket	Left pocket	Abdomen
Gram positive	21(14.9)	32(22.7)	37(26.2)
Gram negative	77(54.6)	51(36.2)	59(41.8)
No growth	43(30.5)	58(41.1)	45(31.9)

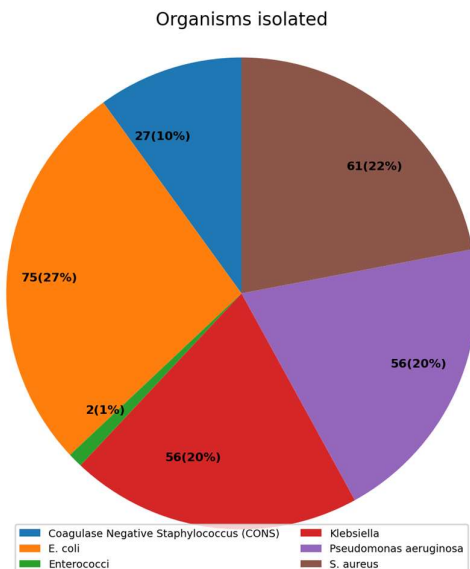


Figure 1: Distribution of organisms isolated from contaminated white coats

Table 2 represents participants’ perceptions regarding the cleanliness and contamination of white coats. Majority of the respondents, 91 (64.5%), did not consider their white coats to be clean merely due to the absence of visible stains. Similarly, 83 (58.9%) disagreed that a coat is clean just because the collar and pockets appear clean. However, only 20 participants (14.2%)

believed that a white coat can be contaminated even without visible stains, while 121 (85.8%) did not perceive this risk. In addition, 27 participants (19.3%) thought their white coat carries germs, whereas 113 (80.7%) did not share this belief. Majority, 129 (91.5%), accepted that the white coat can act as a potential transmitting agent for pathogens.

Table 2. Distribution based on perception towards white coat and its contamination (n=141)

Perception towards white coat and its contamination	Yes n(%)	No n(%)
Do you perceive your white coat to be clean if it has no stains?	50 (35.5)	91 (64.5)
Do you perceive your white coat to be clean if collar and pockets are clean?	58 (41.1)	83 (58.9)
Do you consider your white coat to be contaminated with or without stains?	20 (14.2)	121 (85.8)
Do you think your white coat carries germs?	28 (19.9)	113 (80.1)
Do you believe that the white coat can be a potential transmitting agent for pathogens?	129 (91.5)	12 (8.5)

Table 3 depicts the association between prevalence of microbial contamination and various factors and coat handling practice. There was a statistically significant association between prevalence and the number of white coats possessed (p=0.030), practice of wearing it during work (p=0.014) and the reason for wearing them (p=0.030). Despite higher absolute contamination

among those wearing the coat continuously no statistically significant association was observed between the method of carrying the white coat and microbial contamination. Also, contamination of coats was more common among those who wore it during transit from hospital to community but without statistical significance.

Table 3: Association between prevalence of microbial contamination with various factors (n=141)

Parameters	Microbial contamination of white coats present n(%)	Microbial contamination of white coats absent n(%)	Chi-square value	p value
No of white coats possessed				
<3	49 (89.1)	6 (10.9)	7.01	0.030*
>3	85 (98.8)	1 (1.2)		
Wearing coat during working hours				
Yes	127 (96.2)	5 (3.8)	6.07	0.014*
No	7 (77.8)	2 (22.2)		
Reason for wearing white coat at work				
Dress code of hospital	80 (97.6)	2 (2.4)	14.0	0.030*
Appear professional	32 (88.9)	4 (11.1)		
To use pockets	6 (100)	0		
Protects from infection others	15 (100)	0		
To cover clothing	1 (50)	1 (50)		
Mode of carrying the white coat				
On the hands	8 (80)	2 (20)	7.20	0.206
Pack in a separate bag	2 (100)	0		
Carry in regular college bag	36 (100)	0		
Wear it all the time	82 (94.3)	5 (5.7)		
Over your shoulders	6 (100)	0		
Location of white coat usage at hospital				
All places	2 (100)	0	6.58	0.254
Ward rounds	93 (94.9)	5 (5.1)		
Patient interactions	22 (100)	0		
Meetings with superiors	8 (80)	2 (20)		
Cafeteria/mess	9 (100)	0		
Time duration of coat usage				
< 8 hours	46 (92)	4 (8)	1.51	0.219
>8 hours	88 (96.7)	3 (3.3)		
Take off white coat before leaving the ward/hospital				
Yes	61 (93.8)	4 (6.2)	0.362	0.548
No	73 (96.1)	3 (3.9)		
Exchange of white coat with co-interns				
Yes	33 (89.2)	4 (10.8)	3.63	0.057
No	101 (97.1)	3 (2.9)		
Wear white coat outside clinical areas				
Yes	37 (100)	0	2.62	0.105
No	97 (93.3)	7 (6.7)		
Wear white coat en-route while coming to hospital from your home				
Yes	62 (98.8)	1 (1.6)	2.75	0.097
No	72 (92.3)	6 (7.7)		
Use of white coat while eating at mess/canteen				
Yes	97 (95.1)	5 (4.9)	0.003	0.956
No	37 (94.9)	2 (5.1)		
Duration of coat usage/week				
<6 days	63 (92.6)	5 (7.4)	1.59	0.208
>6 days	71 (97.3)	2 (2.7)		
Wash white coat daily after clinical postings				
Yes	40 (97.6)	1 (2.4)	0.782	0.377
No	94 (94)	6 (6)		
Use hot water to clean the white coat				
Yes	45 (95.7)	2 (4.3)	0.075	0.784
No	89 (94.7)	5 (5.3)		
*p value < 0.05 – statistical significance (Fisher's test)				

Table 4 shows the association between Coat handling practices with baseline characteristics. Coat handling practice was scored and categorized into two categories as good and poor practice with a median cut-off score of six and a maximum of 13. In the current study majority of the participants had poor coat handling practice 80(56.7%). There is a statistically significant association

between area of residence with good practice. Participants residing off-campus had higher proportion of good practices (54.3%) compared to those staying in-campus (32.4%) (p=0.009). This suggests that place of residence may influence adherence to proper coat handling practices.

Table 4: Association between Coat handling practices with baseline characteristics (n=141)

Baseline characteristics	Good coat handling practices n(%)	Poor coat handling practices n(%)	Chi-square value	p value
Gender				
Male	27(46.6)	31(53.4)	0.43	0.51
Female	34(41)	49(59)		
Area of residence				
In-campus	23(32.4)	48(67.6)	6.88	0.009*
Off-campus	38(54.3)	32(45.7)		
Started internship since how many months				
< 1 month	14(66.7)	7(33.3)	6.84	0.07
1 – 6 months	19(41.3)	27(58.7)		
7 - 12 months	28(38.9)	44(61.1)		
>12 months	0	2(100)		
*p value < 0.05 – statistical significance				

DISCUSSION:

White coats have long been seen as a representation of the medical profession, symbolizing respectability and authority. However, according to a number of studies, they may serve as carriers of pathogenic organisms and contribute to the spread of infections. 134 of the 141 medical interns in the current study had contaminated coats, yielding a 95% prevalence of contamination. Srinivasan M et al. (12) and Noor F et al. (13) have showed a similar prevalence rate (95%), while other studies have shown contamination rates ranging from 23% to 95%. (5,11-15) The higher prevalence found in the current study could be due to the fact that it was conducted in a tertiary hospital. The extended life duration of microorganisms on fabric materials like cotton or polyester, which typically varies from 10 to 98 days, as well as variations in research populations and geographic settings, may all contribute to variations in prevalence.

The most commonly isolated organism from the interns' coat was *E. coli* (27%), followed by *S. aureus* (22%), while *Klebsiella* spp. and *P. aeruginosa* accounted for 20% each. Similar higher prevalence of *E.coli* was reported by Kumar PA et al. (9), whereas Muhadi et al. (16) Treacle et al. (7) and Wong et al. (17) found *S. aureus* to be predominant. Whereas, Uneke et al. (5) reported diphtheroids as the major isolate. These variations may be due to varying patient profile in the hospitals, hand hygiene, coat handling practices among the participants, it could also be attributed to the site of coat sample collected, microbiological and culture methods adopted.

In the present study, although 64.5% and 58.9% of participants did not believe their white coats to be clean based merely on the absence of stains or the look of clean collars and pockets, only 14.2% acknowledged that contamination may be present even without evident soiling. Similar perception levels were observed in studies by Trupti B et al. (18) Banu et al. (1) Muhadi et al. (16) and Nwankwo B et al. (19) where, majority of the participants acknowledged that white coats carry pathogens and may act as transmission sources. In contrast, Rashmi R et al. (20) reported comparatively lower perception (52.5%). These differences may be attributed to variations in infection control training undergone by the participants, hospital emphasis on hygiene and infection control policies. The findings highlight the need for improved educational initiatives on microbial contamination and the importance of regular laundering and strict hygiene practices.

There was a statistically significant association between the place of living and improper coat handling practices among the 80 participants (56.7%) in this study. Compared to participants who stayed inside the campus, those who lived off campus showed a greater percentage of better practice (p=0.009). According to Chan CK et al., 239 individuals (48.6%) exhibited moderate practice. (21) This implies that a person's housing may have an impact on their adherence to appropriate coat handling procedures. This could also be because people who live off campus may interact with the community and public spaces while traveling.

A statistically significant correlation was found between the number of white coats owned and the prevalence of microbial contamination (p=0.030). Microbial contamination was more common in participants with more than three white coats than in those with less than three coats. This implies that having several coats do not always lower contamination, which may be the result of improper rotation or laundry procedures. Practice of wearing coat during working hours (p=0.014) and the reason for wearing them (p=0.030) also showed significant association between prevalence of contamination. This shows the contact with patients during clinical rounds, sample collection and interaction leads to a strong source of contamination of coats. Similar to the current study's findings, studies by Qaday et al. and Treacle et al. found no significant correlation between contamination of white coat and any of the parameters. (11,7) This discrepancy in results could be the result of different white coat sampling locations, participant profiles, and improved coat handling techniques.

CONCLUSION:

The prevalence of contamination of white coat was high in this study and the contamination poses a preventable risk. *E. coli* was the most commonly isolated organism followed by *s. aureus* and right pocket area was the most contaminated site. There was a statistically significant association observed between prevalence and the number of white coats possessed, practice of wearing it during work and the reason for wearing them. Also, majority of the participants had poor coat handling practice and a significant association between area of residence.

Thus, there is an urgent need to strengthen hygiene education, enforcing strict laundering policies, restricting white coat use to clinical areas, and implementing periodic microbiological surveillance can mitigate contamination risks. These measures are essential for reducing HAIs, antimicrobial resistance and ensuring safer clinical environments

LIMITATIONS:

Antibiotic sensitivity pattern was not performed for the obtained samples. Since this was a cross-sectional study causality between white coat contamination and infection transmission could not be established. Also, variability in the clinical postings among the participants could have influenced the findings.

RECOMMENDATIONS:

As the study reported a higher prevalence of microbial contamination and poor practices among the participants, regular health education regarding the safe coat handling practices needs to be reinforced to the interns as they are in constant contact with the patients. Further research needs to be done using freshly laundered, unworn white coats as controls. Antibiotic sensitivity analysis should also be carried out for pathogenic isolates.

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REFERENCES

- Banu A, Anand M, Nagi N. White coats as a vehicle for bacterial dissemination. *J Clin Diagn Res.* 2012;6(8):1381-4.
- Hegde BM. Sad Demise of the Doctors' White Coat. *JACM.* 2008;9(1):13-4
- Robati R, Farokhi MM, Jaber FM, Hashemi SA. Effect of white coats on spread of nosocomial infection. *Eur. J. Exp. Biol.* 2013;3(3):156-9.
- Huber SJ. The white coat ceremony: a contemporary medical ritual. *J. Med. Ethics.* 2003;29(6):364-6.
- Uneke CJ, Ijeoma PA. The potential for nosocomial infection transmission by white coats used by physicians in Nigeria: implications for improved patient-safety initiatives. *HR Resources Database. World Health Popul.* 2010;11(3):44-54.
- Landry M, Dornelles AC, Hayek G, Deichmann RE. Patient preferences for Doctor attire: the White Coat's place in the medical profession. *Ochsner J.* 2013;13(3):334-42.
- Treacle AM, Thom KA, Furuno JP, Strauss SM, Harris AD, Perencevich EN. Bacterial contamination of health care workers' white coats. *Am. J. Infect. Control.* 2009;37(2):101-5.
- WHO Guidelines on Prevention and Control of Hospital Associated Infections 2002. [Accessed on: 20-01-2026]. Available at: <https://apps.who.int/iris/bitstream/handle/10665/205187/B0007.pdf?sequence=1&isAllowed=y>
- Kumar PA, Chougale RA, Sinduri I. Bacterial Contamination of White Coats among Medical Personnel-A Cross Sectional Study in Kolhapur, India. *J. pure appl. microbiol.* 2020;14(2):1405-11.
- Saxena RK, Bhosale A, Kazi M, Shirahatti R, Panchwadker D, Diwaney S. Microbial flora on aprons of Dental healthcare professionals. *J. Dental & Allied Sci.* 2013;2(2):54-56.
- Qaday, J., Sariko, M., Mwakyoma, A., Kifaro, E., Mosha, D., Tarimo, R., Nyombi, B. and Shao, E. 2015. Bacterial contamination of Medical doctors and students white coats at Kilimanjaro Christian Medical Centre, Moshi, Tanzania. *Int. J. Bacteriol.*, 1-5.
- Srinivasan M, Uma A, Vinodhkumaradithyaa A, Gomathi S, Thirumalaikolundusubramanian P. The Medical Overcoat – Is It a Transmitting Agent for Bacterial Pathogen?. *Jpn. J. Infect. Dis.* 2007;60:121–2.
- Noor F, Jayanthi RS. The study of microbial flora on doctors white coats in tertiary care hospital in outskirts of Hyderabad, Telangana, India. *Int J Res Med Sci* 2016;4:2705-12
- Mwamungule S, Chimana HM, Malama S, Mainda G, Kwenda G, Muma JB. Contamination of health care workers' coats at the University Teaching Hospital in Lusaka, Zambia: the nosocomial risk. *J. Occupational Med. Toxicol.* 2015;10(34):1-6.
- Pilonetto M, Rosa EA, Brofman PR, Baggio D, Calvário F, Schelp C et al. Hospital gowns as a vehicle for bacterial dissemination in an intensive care unit. *Brazilian J. Infectious Dis.* 2004;8(3):206–10.
- Muhadi SA, Aznamshah NA, Jahanfar S. A cross sectional study on the microbial contamination of the medical student's white coats. *Malayasian J. Microbiol.* 2007;3(1):35-8.
- Wong D, Nye K, Hollis P. The microbial flora on doctor's white coats. *British Medical J.* 1991;303:21-8.
- Trupti B. Naik, Amruthkishan Upadhyay, Vijaykumar Mane, Asmabegam Biradar. Microbial Flora on Medical Students' White Coat and an Analysis of its Associated Factors: A Cross Sectional Study. *Int.J.Curr.Microbiol.App.Sci.* 2016;5(7): 353-363.
- Nwankwo B, Bako V, Hamza KL, Onoja-Alexander MO, Amadu L, Olorukooba AA. Role of healthcare personnel attire in the spread of healthcare-associated infections: Knowledge of healthcare workers in a tertiary hospital in northwest Nigeria. *J Med Trop* 2018;20:123-7.
- Rashmi R, Kumar PGN, Prashant GM, Hirekalmath SV, Imranulla M, Mohammadi SN et al. Perception and attitude towards wearing white coats in public places among dental undergraduates and postgraduates of Davangere City, India *Br J Med Med Res.* 2015;12:1–10.
- Chan CK, Lam TY, Mohanavel L, Ghani JA, Anuar AS, Lee CJ et al. Knowledge, attitude, and practice of white coat use among medical students during clinical practice (LAUNDERKAP): A cross-sectional study. *Am. J. Infect. Control.* 2024;52(1):35-40.