

## SHORT COMMUNICATION

### A cross sectional study of microbial contamination of medical students' white coat

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#### ABSTRACT

The objective of this study is to determine the incidence of microbial contamination on medical students' white coats, the way they handle and clean their white coats and their perception towards contamination. For this purpose, cross sectional survey of the bacterial contamination of white coats in a medical college has been carried out in 3 different locations; Royal College of Medicine, Perak, University of Kuala Lumpur and a private college attached to Ipoh General Hospital. It was found that the incidence of *Staphylococcus aureus*, was 32% on short-sleeved and 54% on long-sleeved white coats. *Bacillus* species was the second most common type of bacteria found. Male collars and female pockets had higher microbial contaminations ( $p=0.01$ ,  $0.03$  respectively). Clinical students' white coats were significantly less contaminated than non-clinical students ( $p=0.001$ ) although they tend to wear it for a longer period ( $5.75 \pm 2.19$  h vs.  $2.32 \pm 0.81$  h) ( $p=0.001$ ). Clinical students owned more short-sleeved coats ( $p=0.001$ ) and washed their coats more often ( $p=0.01$ ) than non-clinical ones. More than eighty one percent of clinical students wear their white coats in the college the majority of whom were females ( $p=0.005$ ). Perception of clinical and non-clinical students towards white coat contamination was similar. Medical students' white coats are contaminated with bacteria and they are potentially source of cross infection. Student's way of handling and washing white coats should be corrected by issuing and following standard guidelines. Students should be bared from wearing white coats in non-clinical areas. Washing hands and using plastic aprons is highly recommended before examining wounds.

*Keywords:* *Staphylococcus aureus*, *Bacillus* species, white coat

#### INTRODUCTION

White coat brings about the standard of professionalism and caring and emblem of the trust doctors must earn from patients. However, wearing white coat in the medical college is not justified unless authorized. Many medical colleges are closely attached to clinical areas and since there is no changing area in the hospital or clinical areas, students wear their white coats on the way to college and even in non-clinical and non-practical classes, library, cafeteria and resting areas around college. It is not an uncommon seen to see white coats are left on chairs or carried around. White coats are known to be potentially contaminated with pathogenic bacteria (Wong, 1991) and there has been always a concern about the risk of transmitting pathogenic bacteria in hospital settings (Nystrom, 1981; Hambraeus, 1973). It is the interest of this study to find out the level and type of microbial contamination present on the medical students' white coats in order to assess the risk of transmission of pathogenic micro-organisms by this route in medical college. Students' way of handling the coat and cleaning as well as their perception towards white coats' contamination was also investigated.

#### MATERIAL AND METHODS

This was a cross sectional study on a group of medical students in Royal College of Medicine (RCMP), University of Kuala Lumpur in Malaysia. Ethical approval was obtained from Ethical committee in RCMP. All the invited students were asked to read the fact sheet and sign the consent form. RCMP is strategically attached to Ipoh General Hospital where medical students take their clinical and bed side training and medical students commute between the two centers daily. One hundred and forty one medical students of different grades were randomly selected to participate in the study. Their mean age was  $22.04 \pm 1.49$  SD. Sixty nine and a half percent were female and 30.5% were male. Fifty one percent of our subjects were non clinical, while the remaining were at clinical stage. Eighty three percent were Malay, 10% were Chinese, 5% were Indian and 2% falls under the others category.

A questionnaire was used to determine their socio-demographic characteristics, perception of their white contamination, and the way they handled and clean their white coats.

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Swabs were taken from four different areas of white coat (collar, pocket, side and sleeves) if the white coats were long-sleeved and from three areas (collar, pocket and side) if short-sleeved. The types of swab in use were the plain, cotton-tipped, sterilized swabs and the sterilized swabs that came along with the transport medium. After collecting the samples, the swabs were immediately brought to the RCMP laboratory and streaked onto Nutrient Agar plates. The plates were then incubated overnight at 37°C.

## RESULTS

### Microbial contamination

The incidence of *Staphylococcus aureus* found on various sites of short and long-sleeved white coats were 32% and 54% respectively. Figure 1 shows the distribution of bacteria found in various sites. For the long-sleeved coats, pocket and sleeves were more frequently contaminated than the side and collar ( $p < 0.05$ ) while for the short-sleeved coats pockets were found to be more frequently contaminated. Table 1 shows number of colonies and type of microbial contamination found in different sites. Mean value for the number of colonies was higher for the pocket site. *S. aureus* was the most common type of microorganism on every site, followed by *Bacillus* species.

Comparing genders in terms of polluted sites, microorganisms were more likely to be isolated from male collars (48.8% vs. 27.6%) ( $p = 0.01$ ) and female pockets (45.9% vs. 27.9%) ( $p = 0.03$ ) but there were no significant difference between genders for two other sites, side or sleeves (in cases with long sleeves). Although more females owned short-sleeved coat (69.7% vs. 30.0%), no significant difference was found between genders in terms of owning a short-sleeved coat.

There were no statistically significant differences in the overall level of microbial contamination in terms of different gender, race, study phases and date of previous wash. However students who study at clinical stage were found to have significantly less contaminated white coats than non-clinical ones ( $1.43 \pm 1.11$  vs.  $1.03 \pm 0.95$ ;  $p = 0.02$ ). This is despite the fact that clinical students wear their white coats significantly longer than non-clinical ( $5.75 \pm 2.19$  hours vs.  $2.32 \pm 0.81$  hours) ( $p = 0.001$ ). The reason could be due to the fact that more clinical students compared with non-clinical owned short-sleeved coats (47.5% vs. 29.8%,  $p = 0.001$ ). Moreover clinical students tend to have a better behavior. When we asked how many days ago did you wash your coat, the mean of days for clinical group was significantly less than that of the non-clinical students ( $8.77 \pm 8.41$  vs.  $26.19 \pm 27.81$ ,  $p = 0.001$ ). Clinical students also washed their coats significantly more often than non-clinical ( $p = 0.01$ ).

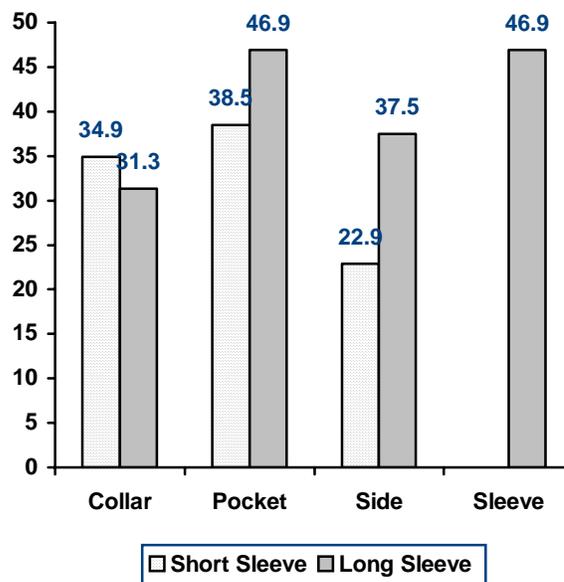


Figure 1: Distribution frequency of bacteria found in various sites.

### Handling and cleaning

None of clinical students had separate coats for clinical areas. 18.8% would only wear their coats in clinical areas while the remaining 81.2% still use their coats for both clinical and non-clinical areas. As for non-clinical students, 47.7% of them wear their white coats in practical classes as required by authorities. Wearing coats in the library was also common (26.9%).

Only 33.3% of students did not wear their white coat in the collage from which only 16.7% gave the reason of contamination. The other reasons mentioned were, it is unnecessary (61.5%), too hot (23.1%), or it lowers students' profile (15.4%).

Males in clinical group handle their white coats better than females ( $2.57 \pm 1.62$  vs.  $1.24 \pm 0.99$ ) ( $p = 0.01$ ) meaning that they do not wear their white coats in the college as often as females ( $p = 0.001$ ). Among clinical students more females tend to wear or carry their white coat on their hand from the hospital site till they reach college rather than packing it in an isolated bag or carrying it on their bag and suitcase (63.8% vs. 2.9%) ( $p = 0.005$ ).

34.4% of students washed their coats once a month, 15.6% once a week and 9.4% twice a month. Remaining 40.6% would wash their coats every two months or even longer. Majority (84.4%) wash their coats by machine.

Number of microbes found on collar and side were significantly higher if students wear their white coats all the time (p=0.05, p=0.001 respectively).

**Perception towards contamination**

Students' perception towards contamination of white coat was examined. Overall, 48.9% of students thought that white coats are always contaminated while 41.9%

considered it completely clean if there was no stain on it and the remaining 9.2% thought it is considered clean if the collar and pockets are clean. 85.8% thought that white coats carry germs and 89.4% believed that white coats can be potential transmission vehicles for pathogens. Table 2 shows clinical and non-clinical students perception towards white coat cleanliness. There was no significant difference between these two groups of students in terms of their perception towards white coat contamination.

**Table 1:** Number of colonies and type of microbial contamination found in different sites

	<b>Collar N (%)</b>	<b>Pocket N (%)</b>	<b>Side N (%)</b>	<b>Sleeves N (%)</b>
<b>No of colony forming units</b>				
0	38 (27.0)	50 (35.5)	50 (35.5)	9 (6.4)
5 and less	86 (61.0)	51 (36.2)	82 (58.2)	20 (14.2)
More than 5	17 (12.1)	40 (28.4)	9 (6.4)	3 (2.1)
<b>Geometric mean (±SD)</b>	3.35 (± 6.25)	4.49 (± 6.36)	2.56 (± 5.85)	3.25 (± 3.2)
<b>Type of Colony</b>				
<i>Staphylococcus aureus</i>	48 (34)	57 (40.4)	37 (26.2)	9 (28.1)
Other <i>Staphylococcus</i> sp.	3 (2.1)	16 (11.3)	27 (19.1)	15 (46.9)
<i>Bacillus</i> sp.	44 (31.2)	12 (8.5)	11 (7.8)	6 (18.8)
<i>Streptococcus</i> sp.	0 (0)	3(2.1)	5 (3.5)	0 (0)
<i>Pseudomonas aeruginosa</i>	0 (0)	0 (0)	3 (2.1)	0 (0)
Gram Positive Cocca Bacilli	6 (4.3)	2 (1.4)	2 (1.4)	0 (0)
Gram Possitive Diplococci	0 (0)	2 (1.4)	2 (1.4)	0 (0)
Gram Negative Bacilli Oxidize	2 (1.4)	1 (0.7)	4 (2.8)	0 (0)
Negative				

**Table 2:** Perception of clinical and non-clinical students towards white coat contamination.

	<b>Non-Clinical (n=72)</b>	<b>Clinical (n=69)</b>	<b>P</b>
<b>How do you perceive cleanliness of your white coat?</b>			
Considered clean if there is no stain			
Considered clean if collar and pockets are clean	32 (44.4%)	27 (39.1%)	
Considered contaminated with or without stain	7 (9.7%)	6 (8.7%)	0.753
	33 (45.8%)	36 (52.2%)	
<b>Do you think your white coat carries germs?</b>	61 (43.3%)	60 (42.6%)	0.668
<b>Do you believe that white coats can be a potential transmitting agent for pathogens?</b>	66 (91.7%)	60 (87%)	0.306

**DISCUSSION**

Traditionally, the white coat is considered to bring credibility and dignity for medical profession. However, white coats have been shown to harbor potential contaminants (Varghese, 1999; Neely, 2000). Result of current study confirmed previous findings. *S. aureus* was the most common type of bacteria found in 54% of long-sleeved coats and 32% of short-sleeved ones. For the long sleeved

white coats, it has been found that *S. aureus* is more likely to be isolated from the sleeve and pocket area. Both sites have the same incidence of 46.9%. These findings are in accordance with those of a previous study where it has been found that bacteria are most likely to be isolated from the pockets and sleeves of white coats since these are the sites of frequent contact (Varghese, 1999). As for the short sleeved white coats, the most common site where *S. aureus* can be isolated from is the pocket area. This, too, is

in accordance with the findings of previous studies (Neely, 2000; Loh, 2000) where the pockets were sites which had the highest percentage of finding bacteria. This is due to the fact that pocket is a site of frequent contact, thus it has a higher possibility of being colonized by bacteria. On the other hand, the side of a short sleeved white coat is the least likely site to isolate *S. aureus*. This is probably because this part of a white coat rarely comes into contact with anything.

The second most common form of microbes found on various sites was *Bacillus* species. This has not been recorded in previous studies. Gram negative bacilli and other forms of microbes which are considered environmental micro-organisms with no clinical significance and skin commensals such as coagulase negative staphylococci were also found which is consistent with previous studies (Derek, 1991; Zachary, 2001; Grabsch, 2006).

Females pocket area was found to be more polluted than males. This could be due to the fact that females use their pockets to keep other accessories although we did not test this theory.

Clinical students were found to have less contaminated coats although they used it for a longer period of time. This is probably because there was greater awareness among clinical students regarding the possibility of white coats becoming a reservoir for pathogens, thus the clinical students tried to wash it more often and use short-sleeved coats to avoid contamination. Non clinical students, however, are not exposed to bed side teaching and hospital environment. Thus, they did not care about the way they handle their white coats.

Although both clinical and non-clinical students had high level of awareness regarding contamination of white coat, they still wear it in different areas in college such as library or classes when not necessary. Male clinical students behaved better than their counterpart females as fewer of them wore white coats in the college. Providing students with changing area in hospital site may reduce the frequency of using white coats in college and non-clinical areas. Some conclusions can be drawn from this study. Frequent wash and use of short-sleeved coats are recommended. Students' behavior towards handling and cleaning white coats is left to be desired. It is recommended that guidelines be set for handling and washing procedures of white coats. Hospitals training medical students should consider providing laundry service.

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#### REFERENCES

- Grabsch, E.A., Burrell, L.J., O'Keeffe, J.M., Ballard, S. and Grayson, L. (2006).** Risk of environmental and healthcare worker contamination with vancomycin-resistant enterococci during outpatient procedures and hemodialysis. *Infection control and hospital epidemiology* **27**: 287 – 293.
- Hambraeus, A. (1973).** Transfer of *Staphylococcus aureus* via nurses' uniforms. *Journal of Hygiene* **71**:799 – 814.
- Loh, W., Ng, V.V. and Holton, J. (2000).** Bacterial Flora on the White Coats of Medical Students. *Journal of Hospital Infection* **45 (1)**: 65 – 68.
- Mims, Dockrell, Goering, Roitt, Wakelin & Zuckerman.** Medical Microbiology, Updated 3<sup>rd</sup> Edition, Elsevier Mosby: 585.
- Neely, A.N. (2000).** A survey of Gram-negative bacteria survival on hospital fabrics and plastics. *Journal of Burn Care & Rehabilitation* **21**: 523 – 527.
- Nystrom, B. (1981).** The contamination of gowns in an intensive care unit. *Journal of Hospital Infection* **2**: 167 – 170.
- Varghese, D. and Patel, H. (1999).** Hand washing: stethoscopes and white coats are sources of nosocomial infection. *British Medical Journal* **319**:519.
- Wong, D., Nye, K. and Hollis, P. (1991).** Microbial flora on doctors' white coats. *British Medical Journal* **303**: 1602 – 1604.
- Zachary, K.C., Bayne, P.S., Morrison, V.J., Ford, D.S., Silver, L.C. and Hooper. D.C. (2001).** Contamination of gowns, gloves, and stethoscopes with vancomycin-resistant enterococci. *Infection control and hospital epidemiology* **22 (9)**: 560 – 564.