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White Coats: A Possible Source of Nosocomial Infections

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Abstract
It has been shown that white coats wore by Medical staff which thought to bring authority and distinction to the medical profession becoming a source of nosocomial transmission of pathogenic microorganisms. In this study we evaluate the different kinds of microorganisms and their intensity present on the white coats of doctors and paramedical staff. In this study we used 100 more than 15 days unwashed white coats which were used and hanged in hospital environment and 100 washed within 15 days and not placed in hospital. The aim of this study was to assess the risk of transmission of pathogenic microorganisms by wearing coats of Doctors and paramedical staff in a hospital environment as well as a comparison of microbial load also being studied between unwashed & home laundered white coats. In this Cross sectional analysis samples were taken through moist swabs from two different areas of the white coat (Pocket and Sleeves) wearing by doctors and lab staffs in different hospital in Karachi, Pakistan. Sample processed in the Microbiology department at Jinnah University for Women according to standard procedures. It was observed that unwashed sleeves and pockets of coats were highly contaminated areas. Bacteria were isolated from the collected samples. In gram positive bacteria 70% *Staphylococcus aureus* and 30% *Staphylococcus coagulase* negative bacteria were isolated. In gram negative bacteria 35% *Klebsiella*, 10% *E.coli*, 10% *Enterobacter,* 10% *Shigella* and 5% *Salmonella* were isolated while 30% show no growth.
Keywords: White coat, Nosocomial infection, Bacterial contamination, non-clinical areas.

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INTRODUCTION

A healthcare-associated infection (HCAI) or nosocomial infection is defined as any infection acquired by hospital environment and also by a healthcare worker, or which is acquired by a healthcare worker in the course of their duties (Treakle *et al.,* 2009). According to the Health and Social Care Act 2008 that prevention and control of nosocomial infection should be part of everyday practice and applied consistently by every individual (Hill, 2011). Nosocomial infections are responsible to increase the morbidity and mortality ratio in hospitals as the health workers and medical staff like doctors, surgeons, nurses carries transmissible agents on their bodies and clothes mainly involving white coats or lab coats, nurses' uniforms and other hospital garments (Jones *et al*., 1995). And they act as a vector of transmission of various nosocomial infections in hospital settings, as they are contaminated with pathogenic organisms such as bacteria, fungi and viruses.

Among all these pathogens bacteria are mainly responsible for nosocomial infections and the risk of nosocomial infection depends on a number of factors (Muto *et al*., 2003; Steinlechner *et al*., 2002). These include the ability of pathogens to remain viable on a surface, the rate at which contaminated surfaces are touched by patients and healthcare workers, the context in which the patient is exposed, and the levels of contamination that result in transmission to patients (Catano *et al*., 2012). Many studies suggest that contaminated environmental surfaces may play an important role in transmission of nosocomial pathogens (Eckstein *et al*., 2007). Clothing including white coats appears to be contaminated in the first few hours of use. Other personnel affected with frequent hand contact such as pens, stethoscopes, and cell phones may have even higher levels of contamination, as bacterial survival ability increases on inanimate surfaces including white coat's fabrics such as cotton or polystyrene (Nye *et al*., 2005).

Cross-sectional transmission of nosocomial pathogens from person to person or from environment to a person is also increased due to the ability of microorganisms to survive on an inanimate surface as mentioned above (Espinal and Marti, 2012). As White coats are used in medical field by healthcare workers for daily purpose to protect their body and their clothes as they are one of the personnel protective equipment which are used in all biosafety levels (BSL) (Munoz-Price *et al*., 2012). The most

contaminated areas of white coats are sleeves and pockets than other areas of white coat such as back, front and collars (Bearman *et al*., 2012). The most isolated organisms from white coats of nurses and paramedical staff are *Staphylococcus aureus* and Enterococcus; whereas fungal species include *Aspergillus* spores and *Candida* (Butler, 2010). Antibiotic sensitivity also influence the survival of pathogens on white coats fabric as Methicillin resistant *Staphylococcus aureus* (MRSA) and Vancomycin resistant *Enterococcus* (VRE) can survive on various fabrics including smooth cotton (clothes) for days; duration of survival depends on the type of bacteria and amount of inoculum of bacteria. *Enterococci* can survive 90 days and shorter inoculum survives shorter time generally for days whereas high inoculum survival time is longer. Therefore, even the low surviving inoculum of pathogens on white coats can cause nosocomial infections but they are mild (Neely *et al*., 2000).

This topic is debatable now whether the white coat should be worn or not by healthcare workers in order to decrease the transmission of nosocomial pathogens. White coats and other long-sleeved coats or uniforms have been banned by the British Department of Health developed guidelines for health care workers but it is also documented by the National Health Service report that there is lacking of evidence that white coats and other long-sleeved uniforms are capable to transmit the nosocomial pathogens (So *et al*., 2013). Although it is mentioned by many studies that white coats and long-sleeved uniforms are contaminated with pathogenic organisms specially bacteria but it is not clear by any study that wearing short-sleeved uniforms and avoiding the white coats decreases the level of nosocomial infection (Baxter *et al*., 2010).Transmission of pathogens occurs either directly or indirectly through inanimate surfaces. Other than white coat, such as neckties, stethoscopes and pens, cell phones also carry potential pathogens. In order to decrease the degree of pathogenic bacteria, improved hand hygiene, environmental cleaning and isolation of patients carrying pathogenic bacteria recommended. Despite clear evidence that hygiene improves surgical outcomes, there remains considerable controversy over whether or not contaminated environmental surfaces contribute to transmission of nosocomial infection causing pathogens (Bhalla *et al*., 2004; Cristina *et al.*, 2013).

The interest of this study is to find out the level and the type of microbial contamination which is present on the paramedical staff's and doctors' white coats in hospital environment in order to transmit the pathogenic bacteria by this route in hospital (Loveday *et al*., 2007).

MATERIALS AND METHODS

Criteria of Sample Collection:

The samples (white coats) were collected from 50 doctors and 50 paramedical staff members of random departments which claimed their hand and attire hygiene from fair to excellent. The samples were allowed to be collected unlaundered. White coats' sleeves and pockets were our area of interest as they are more likely to be contaminated and exposed to the patients. 25 out of 50 white coats from each group (i.e. doctors and paramedical staff) were earmarked for the isolation of micro-organisms from sleeves and remaining 25 white coats from each group for the isolation from pockets.

Bacterial isolates

A total of 100 samples were included in this study. These samples (white coats) were taken from doctors and paramedical staff of different hospitals in the period of Jan 2013-December 2013. The cultures obtained from the samples were isolated through swab technique and were inoculated in transport media to carry them to the laboratory of Jinnah University for women. The cultures were streaked on Nutrient agar plates initially and were incubated at 37˚C for 24hrs. After incubation, the isolates were streaked on MSA and MacConkey agar plates and then incubated in same previous manner. Identification of the isolates was done on the basis of morphological, biochemical and cultural characteristics (Bergey, 1984; Iqbal *et al.,* 2015). Morphology was determined through gram staining. Catalase test, Coagulase test, Urease test, Nitrate test, IMViC Tests and TSI reaction was performed to check the typical reaction of strains obtained. Gram positive organisms including *Staphylococcus aureus*, coagulase negative *Staphylococcus* (*S.epidermitis*) and Gram negative organisms' including *Klebsiella*, *E.coli*, *Salmonella*, *Shigella* and *Enterobacter*were identified.

RESULTS

An overall result showed the presence of Gram positive organisms including 70% *S.aureus*and 30% *S.epidermitis*, while Gram negative organisms including 35% *Klebsiella*, 10% *E.coli*, 10% *Enterobacter*, 10% *Shigella* and 5% *Salmonella*. These results evaluate the higher percentage of existence of Gram negative organisms which are pathogenic and may cause severe diseases in patients. Various samples showed bacterial prevalence in the following way.

Samples from unwashed sleeves of doctors' white coats showed 100% bacterial growth. 35 isolates were observed on agar plates, out of which 18 (51%) were *S.aureus*, 10 (29%) *Klebsiella*and 7 (20%) were *Coagulase negative* (Table 1).

Samples from washed sleeves of doctors' white coats showed 48% bacterial growth. 14 isolates were observed on agar plates, out of which 9 (64%) were *S.aureus*, 2 (14%), *Coagulase negative*, 2 (14%) *Klebsiella* and 1 (7%) *Enterobacter* (Table 1).

Samples from unwashed pockets of doctors' white coats showed 100% bacterial growth. 36 isolates were observed on agar plates, out of which 19 (53%) were

S.aureus, 5 (14%) *Coagulase negative,* 2 (6%) *E.coli*, 8 (22%), *Klebsiella* and 2 (6%) *Enterobacter* (Table 1).

Samples from washed pockets of doctors' white coats showed 40% bacterial growth. 11 isolates were observed on agar plates, out of which 6 (55%) were *S.aureus*, 2 (18%) *Klebsiella*, 2 (18%) *Coagulase negative* and 1 (9%) were *E.coli* (Table 1).

Samples from unwashed sleeves of paramedical staff's white coats showed 100% bacterial growth. 46 isolates were observed on agar plates, out of which 17 (37%) were *S.aureus*, 8 (17%) *Coagulase negative*, 9 (20%) *Klebsiella*, 3(7%) *Shigella*, 3 (7%) *Enterobacter* and 6 (13%) were *E.coli* (Table 1).

Samples from washed sleeves of paramedical staff's white coats showed 44% bacterial growth. 13 isolates were observed on agar plates, out of which 5 (38%) were *S.aureus* 3 (23%) Coagulase negative 2 (15%), *Enterobacter* and 2 (15%) were *Klebsiella* (Table 1).

Samples from unwashed pockets of paramedical staff showed 100% growth. 47 isolates were observed on agar plates, out of which 10 (21%) were Coagulase negative, 15 (32%) *S.aureus*, 4 (9%) *Salmonella*, 2 (4%), *Enterobacter*, 7 (15%) *Klebsiella*, 7 (15%), *Shigella* and 2 (4%) were *E.coli* (Table 1).

Samples from washed pockets of paramedical staff showed 44% bacterial growth. 14 isolates were observed on agar plates, out of which 9 (64%) were *S.aureus*, 3 (21%) *Klebsiella*and 2 (14%) were *Coagulase negative* (Table 1).

Table 1. Prevalence of bacteria on white coat samples

White Coats Samples			Type of bacteria (%age)						
		Sample site	*S.aureus*	*Klebsiella*	*Coagulase negative*	*Enterobacter*	*E.coli*	*Shigella*	*Salmonella*
Doctors		Unwashed Sleeves	51	29	20	-	-	-	-
		Washed Sleeves	64	14	14	7	-	-	-
		Unwashed Pocket	53	22	14	6	6	-	-
		Washed Pocket	55	18	18	-	9	-	-
Paramedical staff		Unwashed Sleeves	37	20	17	7	13	7	-
		Washed Sleeves	38	15	23	15	-	-	-
		Unwashed Pocket	32	15	21	4	4	15	9
		Washed Pocket	64	21	14	-	-	-	-

DISCUSSION

White coats of doctors and paramedical staff play an important role in the transmission of pathogenic bacteria to the patients admitted in the hospitals (Muto *et al.,* 2003; Treakle *et al.,* 2009; Hill, 2011). It is becoming a life-threatening issue as the admitted patients have low immunity and are more susceptible than the patients which are not hospitalized. Most commonly isolated bacterium is *Staphylococcus aureus* (Sande and Basak, 2014; Qaday *et al.,* 2015) which is the normal flora of the skin but can be an opportunistic pathogen and can cause opportunistic infections. Role of white coat in transmission of pathogenic microbes is poorly recognized (Bearman, 2012).

We found that the sleeves and the pockets are the areas which are more contaminated than the rest of the coat. It shows that poor hand hygiene is the basic root cause of transmission of pathogenic bacteria. Good hand hygiene can reduce this route of transmission and can stop the spread of these harmful bacteria (Hill, 2011). Sande and Basak. (2014) found that the rate of contamination with pathogens, was higher on pockets (57.4%) compared with abdominal zone (27.6%) and sleeve ends (14.8%).

Numerous studies have conceded throughout the world to see the transmission of pathogenic bacteria from white coats. In a recent study, similar work was done which showed the presence of different pathogens, like *S.aureus*, *S.epidermitis*, *Klebsiella*, *Enterobacter*, *Acinetobacter*, *Pseudomonas*, on the white coats, paramedical staff and the students. Sande and Basak. (2014) showed that 26.2% samples were positive for pathogenic bacteria out of 94 isolated pathogens 33 (35.1%) were *Staphylococcus aureus* (6 MRSA, 27 MSSA), 56 gram negative bacilli (17 ESBL producers). Comparing to these results, our study showed the presence of the pathogenic bacteria is on the rise which maybe serious in future. These pathogens pose great

challenge to health authorities and cause many outbreaks in recent times.

It is observed that this emerging issue can be a real critical problem for hospitalized patients and other individuals as the pathogens can become multi-drug resistant. It is the need of time to review the surveillance programs to give knowledge about good hand hygiene. In this way the transmission of the pathogenic organisms will be comparatively reduced.

CONCLUSION AND SUGGESTIONS

This study suggests that the use of white coats may play a vital role in spreading the nosocomial infections to the community. Results showed that the usage of white coats should be restricted in non-clinical area and proper washing practice should be conducted in order to get the better result. Proper attention on prevention and care should be followed to reduce the risk of spread of nosocomial infections to the community.

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CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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