White Coat as a Contamination Agent

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Abstract

Background: The study was delineated from the hypothesis of the irrational use of the white coats outside the place destined to its use, in that way transforming it into agent of contamination.

Methods and findings: We developed a questionnaire to be answered by volunteers approached on the campus of a private university, aiming at a social study of the reasons for the use of the white coat and awareness about its function. Our main limitation was in relation to medical students who only perform ambulatory care in associated clinics, but off campus.

Results: The antibiogram didn't show no one significant resistance profile, instead of other studies that reporting even *Staphylococcus aureus* MRSA, but some Gram-positive isolates showed resistance for Penicillin, Ampicillin and Gentamicin and all Gram-negative isolates showed resistance for Amoxicillin.

Conclusions: We can conclude that, mainly among students in the area of human health, there is a disinformation or disregard for the risk of transmission of pathogens by the lab coats. We found microorganisms of various types, mainly yeasts; however, among the isolated Gram-positive cocci, *Staphylococcus aureus* and coagulase-negative *Staphylococcus sp.* were the ones that corresponded to the largest number.

Keywords: White-coat; Lab-coat; Contamination; *Staphylococcus*; *E. coli*

Introdution

The white coat, in Brazil, is still no legislation that standardize white coat with according to the function performed of its users [1]. Nevertheless, it is recognized that it is necessary to use it for personal protection and, therefore, educational and research institutions, companies and health facilities require its use.

Concomitant with this awareness of individual protection, we frequently see the use of the white coat in improper environments, such as dining rooms, coffee shop and even shopping malls, generating the risk of cross contamination between environments. Between health professionals, frequently, the seriousness of the issue is neglected by arrogance or ignorance of some basic concepts of microbiology [2,3].

Studies have shown that uniforms and white coats have become progressively contaminated during their use and that the contamination reaches a saturation level until stabilizing in a plateau [2]. So, the objectives of this study were to evaluate the level of contamination of white coats of students, professors and employees of a private university, with identification of microorganisms, verification of potential virulence and resistance to antibiotics. In parallel, we try to relate the level of contamination with the frequency of exchanges per week and conduct a social study on the habits of use of the white coat.

Materials and Methods

For the accomplishment of the study, collections were made with interviews at the Campus of biologic and health activities.

The voluntary was approached and invited to participate in the study anonymously. A questionnaire was answered (**Figure 1**) while one of the research components carried out the material collection.

The collections were performed in the region of the collar, pocket and wrist of the user's dominant hand (right-handed or left-handed). Sterile swabs and a template, used to delineate the collection area, were used to collect the samples and thus calculate the number of contaminants per area. The collected samples were identified by code.

The volunteers received a code corresponding to their analysis, if there was interest in the results.

In the Microbiology laboratory the samples were inoculated in Plate Count Agar (PCA), BHI broth (Brain Heart Infusion Broth) and Blood Agar, in order to perform the counting of the microorganism and identification of these. They were then incubated under 36°C for 48 hours, for the growth of bacterias, and under 25°C for until 7 days, for the growth of fungus.

After growth, counting and identification were performed. Some isolated microorganisms were selected for antibiotic resistance testing.

Figure 1 Questionnaire conducted with the volunteers.

Results

Results of the questionnaire (Social study)

Of the total number of volunteers, 58% were female and, of the total, 72% were students and, the other, professor or laboratory employees. In an overall assessment, when asked about the reasons for the use of the white coat, most interviewees responded that they used it for safety (**Table 1**).

Table 1 Results of social study according the questionnaire.

Reasons for Use of White X Coat					
	Safety	**Obligation**	**Work uniform**	**Protection of sample**	**TOTAL**
Women (total of volunteers)	81%	14%	0%	5%	100%
Men (total of volunteers)	53%	33%	13%	0%	100%
Students	30%	62%	4%	4%	100%
Reasons for Use of White Oat According to Professional Group					
	Safety	**Obligation**	**Work uniform**	**Protection of sample**	**TOTAL**
Laboratory employees / Professor	90%	0%	10%	0%	100%
Medicine students	0%	100%	0%	0%	100%
Veterinary Medicine students	100%	0%	0%	0%	100%
Pharmacy students	50%	0%	0%	50%	100%
Chemistry Engineer students	100%	0%	0%	0%	100%
Dentistry students	0%	100%	0%	0%	100%
Biology students	50%	25%	25%	0%	100%
Other Engineers students	75%	25%	0%	0%	100%
Place of Use of the White Coat According to Professional Group					
	Outside Workplace		**At Workplace**		**TOTAL**
Laboratory employees / Professor	40%		60%		100%
Medicine students	33%		67%		100%

Veterinary Medicine students	0%	100%	100%
Pharmacy students	0%	100%	100%
Chemistry Engineer students	0%	100%	100%
Dentistry students	0%	100%	100%
Biology students	0%	100%	100%
Other Engineers students	33%	77%	100%

However, when we analyzed exclusively the student's responses, most of them (35%) had responded that they were using for obligation (**Table 1**). Our results correspond to the results of Banu et al. who report several reasons for the use of white coat beyond for safety [4].

Analyzing the students' responses per course, most of them do not admit to wearing their white coat outside the study work place (**Table 1**), however this does not correspond to what is observed within the Campus. The fact that drew our attention was that the groups that most answered about the use of obligation of white coats were medical students and students of dentistry. This fact shows us the lack of preoccupation or few information about the possibility of the white coats is an important pathogens vehicle.

Results of microbiologoical analyzes

Microbiological analyzes of the level of contamination show that there is no significant difference between the analyzed sites (collar, pocket and sleeve), but confirm the idea that, the higher the frequency of exchanges (washes), the lower the level of contamination, as shown, for example, in pockets analyzes (**Figure 2**).

Priya et al. as well as Treakle et al. showed the same profile of cleaning habits and exchange of white coat that our study, where and students generally do not show concern about the possibility of transmission of pathogens to other people or to themselves [5,6].
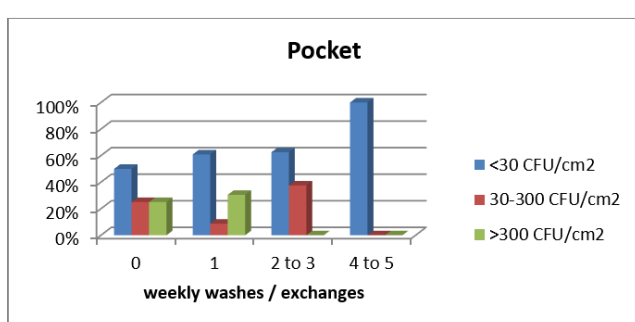

Figure 2 Pockets contamination level according to number of weekly washes / exchanges.

We did not find a high microbial count in most of the analyzed white coats, but when analyzing the types of isolates besides the high presence of fungi and yeasts, we found several groups of bacteria.

Microorganisms of various species was identified, such as *Staphylococcus aureus*, coagulase-negative *Staphylococcus*, *Streptococcus viridans* group, *Enterococcus sp.*, *Escherichia coli*, and *Pseudomonas sp.* among other bacteria, besides yeast (that corresponded to 50% of the isolates) and filamentous fungi like *Aspergillus sp.* and *Penicillium sp.* In contraste, Margarido et al. report in their research the frequency of 50% of *Staphylococcus sp.* in their research about the white coat of health academics. In other researchers, was found just *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *E. coli* [3,7].

The antibiogram didn't show no one significant resistance profile, instead of other studies that reporting even *Staphylococcus aureus* MRSA, but some Gram-positive isolates showed resistance for Penicillin, Ampicillin and Gentamicin and all Gram-negative isolates showed resistance for Amoxicillin, even as reported Robati et al. [4,6,8].

Discussion

According to other researchs, the possible justifications for the indiscriminate use of lab coats outside the work environment can be mentioned: the short time available for the exchange of clothing, the fact that the professionals do not give due importance to the risk of contamination, or because their use in public places would be related to status [9]. This was also shown in our study, mainly by students of medicine and dentistry, that's which leads us to concern with the type of professional we are training. The irresponsible use of white coats outside the appropriate place is reported by Robati et al. showing that this problem is frequent, mainly between human health students

Although several studies have shown that even with progressive contamination of the lab coat, associated with poorly performed changes or washes, there is a growth plateau, however other studies have shown that the survival of microorganisms in tissues, such as cotton and polyester, can last 10 to almost 100 days [2,8].

The contrast of other researchers with our isolates can be explained to the focus of the volunteers. In most studies, volunteers are from the health area. In our work, we do not limit the area where the volunteer works or studies. Anyway, among the Gram-positive cocci we isolated, *Staphylococcus aureus* and *Staphylococcus sp.* corresponded to the majority of the isolates.

The presence of *E. coli* and *Pseudomonas sp.* reveals a poor hygiene or hygiene done erroneously. These observations are refforced for the fact that, at the end of the analysis, there was interest from many volunteers in knowing the correct way to carry the white coat and the best way to decontaminate it. Besides that, during the data collection it was observed, also, people attending the bathroom using the lab coat, which may justify some of the isolates of coliforms.

Staphylococcus aureus, *Pseudomonas aeruginosa* and *Escherichia coli* are considered to be frequent pathogens, ranging from simple, like localized infections, to septicemia, depending on their port of entry and host susceptibility. Coagulase-negatives *Staphylococcus* are considered commensals of the skin, but in situations of immunosuppression they can cause severe infections [10].

Among the yeasts, the most important clinical is *Candida albicans* that can be found in 40 to 80% of normal humans, being present in the intestine and vagina mouth. In states of immunosuppression, they can cause infections [11].

Throughout the world there is a constant concern with infections by *Staphylococcus aureus*, *Enterococcus faecium* and *Pseudomonas aeruginosa* due to the high pathogenicity, the ease of cross-transmission and the greater resistance of these microorganisms to antimicrobials [12]. Depending on the resistance profile of the strains, these microorganisms, such as *Escherichia coli*, may lead to severe gastroenteritis, pneumonia and pharyngitis [2].

Our antibiograms results showed a good sensitivity profile for isolates. The isolates that presented some resistance profile came from the dentistry student's white coats. Medical students who attend the campus normally only do clinic attendance. Practical outpatient procedures are performed at out-of-campus outpatient clinics, which may have limited our endurance profile results.

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