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EVALUATION OF MICROBIAL CONTAMINATION IN MEDICAL OBJECTS: A PROSPECTIVE OBSERVATIONAL CROSS-SECTIONAL STUDY

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ABSTRACT

Introduction: Healthcare-related infections (HCIs) include those that can be acquired as a result of any health care provided and may be caused by microorganisms present in various personal items of professionals during the provision of health care. The strains of microorganisms found in these personal items have shown high pathogenicity, ease of cross-transmission, and a reduced profile of sensitivity to different antibiotics. **Objective:** This study sought to assess the microbial contamination of lab coats and stethoscopes by health professionals at a private hospital in Sao Jose do Rio Preto-Sao Paulo, as well as bacterial resistance to antibiotics. This was done due to the complexity of bacterial resistance in the management of nosocomial infections. **Methods:** The method in which the samples were collected by swab, transferred to BHI broth for 24 hours at 37^0C, and sown on Mannitol, MacConkey, and Sabouraud. Bacteria with different morphologies were selected from Mannitol and MacConkey for the antibiotic sensitivity test. Bacteria with different morphologies were selected from Mannitol and MacConkey for the antibiotic susceptibility test. **Results:** The following microbes have been present in the objects: Staphylococcus aureus (48%), coagulase-negative Staphylococcus (37%), bacilli (7%), and Enterococcus sp and yeast fungi (4%). Regarding bacterial resistance to antibiotics, 92% of the bacteria were resistant to penicillin, 65% to erythromycin, 35% to oxacillin, 19% to norfloxacin, 19% to vancomycin, and 4% to gentamicin. **Conclusion:** This study consolidates to foster a widespread discussion about the role of lab coats and stethoscopes in the propagation of intra-hospital microorganisms to a community and from patient to patient. It has been found that the stethoscopes and lab coats of all health professionals contained microbial contamination, in addition to some multi-resistant antibiotic strains.

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INTRODUCTION

Healthcare-related infections (HCIs) include those that can be acquired as a result of any health care provided, regardless of hospitalization, and may be caused by microorganisms present in various personal items of professionals during the provision of health care (Hayajneh, 2021; Pandey, 2019; Wong, 2019).

It is recognized that these objects are progressively contaminated during care with patients, making them potential vehicles for microbial transmission (Hayajneh, 2021). In this way, this situation becomes an important public health problem, as it can cause an increase in morbidity and mortality rates, prolong the period of hospitalization and increase hospital costs (Carvalho, 2009; Takashima, 2004; Schabrun, 2006). Another worrying fact is that the spread of pathogens can occur both in the hospital environment and outside it, that is, in places where direct care is not provided.

This is because the use of lab coats by health professionals, outside the hospital environment, has become common in areas close to health institutions, buses, and cafeterias (Hayajneh, 2021; Margarido, 2014). Also, the strains of microorganisms found in these personal items have shown high pathogenicity, ease of cross-transmission, and a reduced profile of sensitivity to different antibiotics. Among the most important species, Staphylococcus aureus stands out, which remains an important pathogen involved in the etiology of HCIs, being able to survive for months in dry clinical samples and resist heat and high concentrations of salt (Bordignon, 2017; Shiomori, 2002).

In that regard, controlling the spread of microorganisms with pathogenic characteristics becomes a challenge for health institutions. Institutions face reduced therapeutic options for the treatment of many cases and complications related to clinical care and also face problems with the patient, which are the reduction of productivity and quality of life of the patient (Siegel, 2019). In this context, it is of great importance to analyze the occurrence of microbial contamination in personal items of health professionals and to point out the similarity with those related to HCIs. Another important factor to be studied in the presence of antibiotic-resistant bacteria, as they represent a threat to clinical utility and an aggravating factor in hospital infections due to the difficulty of treatment and alteration of the patient's prognosis (Hayajneh, 2021). Thus, the present study evaluated the microbial contamination of lab coats and stethoscopes of health professionals (doctors, nurses, and nursing technicians), as well as the level of sensitivity of bacteria to antibiotics.

METHODS

Study Design: This study followed a prospective observational cross-sectional model, following the rules of clinical research of the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology), available at: https://www.strobe-statement.org/.This was a cross-sectional and experimental study, in which samples of health professionals' materials were collected in a private hospital in the city of Sao Jose do Rio Preto, Sao Paulo, and analyzed at the Research Laboratory of the Faceres Faculty of Medicine.

Ethical Approval: This study was analyzed and approved by the Research Ethics Committee according to a substantiated opinion number 2.506.752, and obtaining the Informed Consent Form according to CNS/CONEP Resolution 466/12. The health professional who agreed to participate in the research signed both copies of the Free and Informed Consent Term and provided the lab coat and stethoscope.

Procedures and Experimental Analysis: An area of 5 cm^2 was delimited on the outside of the two sleeves of the lab coats so that the sample was collected by a swab soaked in sterile 0.9% saline solution and rubbed in rotating movements. The same procedure was performed with the total diaphragm area of the stethoscopes. After collection, the swab was placed in a 0.9% saline solution arranged in test tubes and transported on ice to the laboratory, where it was transferred to BHI broth for 24 hours at 37°C. After this period, the samples were plated on Mannitol agar, MacConkey agar, and Sabouraud agar. The plates were incubated between 24 and 48 hours at 37°C and then the number of colonies forming units (CFU) was counted and colonies with different morphologies were identified by the Gram method, in addition to biochemical analyzes for the bacteria. Gram-positive (catalase and coagulase test). The antibiotic susceptibility profile of morphologically different bacteria isolated (Gram-positive and Gram-negative) was determined against various antimicrobial agents using agar diffusion tests (Kirby-Bauer), according to the recommendations of the Clinical and Laboratory Standards Institute (Scheithauer *et al*., 2010). The following antibiotics were tested for Staphylococcus bacteria: erythromycin, gentamicin, norfloxacin, oxacycline, penicillin, and vancomycin. And for Gram-negatives and those of the *Enterococcus genus*, ciprofloxacin, erythromycin, gentamicin, and norfloxacin were tested.

RESULTS

Twenty samples were obtained from the lab coat and stethoscopes of ten health professionals, three physicians, four nurses, and three nursing technicians. All samples analyzed showed microbial growth and 48% of the isolated microorganisms were identified as belonging to the *Staphylococcus aureus*bacterial species, 37% to the coagulase-negative Staphylococcus group, 7% to Gram-negative bacteria, and 4% to *Enterococcus sp* and yeast fungi. Of the total number of bacteria, there was a predominance of 92% of Gram-positive bacteria (Table 1).

Table 1. Percentage of microorganisms present in samples collected from health professionals' stethoscopes and lab coats

Samples/Professional	S. aureus	S. coagulase	Gram (-)	Entero coccus	Yeasts
labcoat/doctor	25%	75%			
stethoscope/doctor	67%	33%			
labcoat/nurse	57%	29%		14%	
stethoscope/nurse	67%	16,5%	16,5%		
labcoat/technician		50%	25%		25%
stethoscope/technician	67%	33%			
Total	48%	37%	7%	4%	4%

Table 1 shows the percentage of microorganisms found in the lab coat and stethoscope of health professionals. A predominance of coagulase-negative Staphylococcus was identified in the coats of physicians and nursing technicians and of *S. aureus* in the stethoscopes of physicians, nurses, and nursing technicians. Gram-negative bacteria, Enterococcus, and fungi were identified on the nurses' lab coats and stethoscopes.

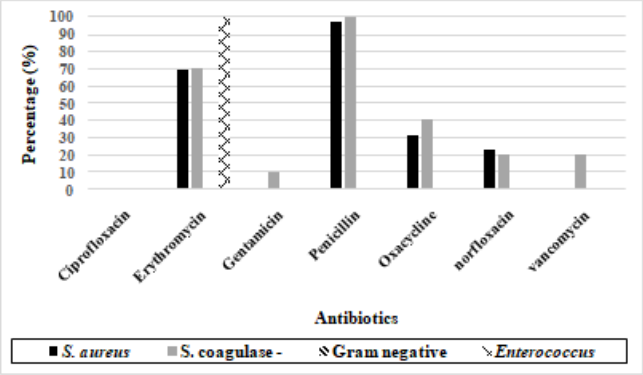

Figure 1. Percentage (%) of bacteria isolated from antibiotic resistant samples

Figure 1 shows the percentage of bacteria obtained from objects resistant to different antibiotics. Specimens from the coagulase-negative S. group were resistant to all types of antibiotics tested, including vancomycin. In addition, one can notice a high percentage of this group of bacteria that showed antibiotic resistance when compared to the other types of bacteria.

DISCUSSION

People seek hospitals when they are sick and debilitated, in addition to being immunosuppressed, becoming more susceptible to contracting some type of infection, with manifestations during the time the patient remains hospitalized or shortly after discharge (Badran, 2007; Oliveira, 2015). The hospital environment can be considered a vector of HCIs, due to the number of objects used in everyday life by health professionals who end up being contaminated (Brandão, 2020). Therefore, combating these infections is a major challenge for health institutions so that the time and cost of hospitalization are reduced, in addition to the risk and chances of patients developing complications (Oliveira, 2015).

Properly following the biosafety standards (Law 8974/1995) is one of the main conducts that must be adopted by health professionals so that the equipment and materials used during patient care do not become responsible for the transmission of microorganisms (Carvalho, 1999; Teixeira, 2014). In 2011, in the state of São Paulo, Law 14,466 was published, which prohibits the use of lab coats or aprons by health professionals outside the work environment, providing financial punishment for those who break the rule (Modesto, 2019). This is because the lab coat, which is used by health professionals to protect them against microbial contamination within work institutions, has been used inappropriately when exposed to the external environment. Thus, this personal object becomes one of the biggest transmitters and reservoirs of bacteria, increasing the risk of contamination of patients, the health professionals themselves, the community in which it is inserted, and resistance to the antibiotic, from the exchange of genetic material between different bacteria (Brandão, 2020; Paula, 2019). A recently published work highlighted the important role of the lab coat in the contamination of patients, with eight deaths associated with transmission through clothing being reported (Vasconcellos, 2020). Another study carried out at the Santa Casa Central Hospital in Sao Paulo showed results similar to those of the present study, with *S. aureus* and coagulase-negative Staphylococcus being the most prevalent, as evidenced in the study with the hospital microbiota (Badran, 2007). It is important to point out that microorganisms can remain viable for up to 98 days in lab coat tissues, with the species *S. aureus* being the most found because it is part of the skin microbiota, in addition to being able to survive for almost a month, thus becoming large contamination factor (Paula, 2019; Lima, 2020).

Other equipment is also responsible for the transmission of microorganisms, such as stethoscopes, one of the most used instruments in the hospital environment to assist in the diagnosis of diseases. A Swiss study on contamination of stethoscopes showed that after the hands of doctors, specifically the dominant one, this object is the biggest vehicle of contamination of patients (Dutra, 2013). As in the analysis of the 81 stethoscopes of health professionals from the hospital of the University of Santa Cruz do Sul, UNISC (Sherestha, 2019), the present study also detected *S. aureus* as the microorganism present in most of these objects. These data are worrying, since bacteria of the genus Staphylococcus are responsible for several infectious processes, from skin manifestations to osteomyelitis and endocarditis, whose consequences are serious (Margarido, 2014). Furthermore, it was possible to verify the significant resistance of the bacteria identified in the present study to the antibiotics erythromycin, penicillin, and oxacillin. A study carried out by Bordignon and Lima (Bordignon, 2017) also showed similar results for the antibiotic sensitivity profile of bacteria that caused infections in a hospital in the state of Paraná.In this way, health professionals must have the knowledge that wrong hygiene can lead to the emergence of resistant bacteria, cause an increase in the severity of nosocomial infections due to multidrug-resistant strains, and worsen the prognosis and health of patients. A simple, but effective approach to avoid this condition is to properly sanitize the hands of professionals and clean the stethoscopes with 70% ethyl alcohol, before and after each patient is treated (Santos, 2015). Also, Sherestha and Reddy (Longtin, 2014) found a 94.6% rate of decontamination of stethoscopes with this chemical compound, showing that the simple act of disinfecting these instruments can be effective in reducing the transmission of several pathogens responsible for nosocomial infections.As for the lab coat, there is no consensus on the frequency of its change, but the recommendation of daily replacement in isolation is emphasized by national and international documents. In addition, washing this part with chemicals should be performed to reduce microbial contamination, with hypochlorite being the most suitable for the disinfection process, at a dilution of 100 parts per million (Scheidt, 2015). Therefore, these objects used by health professionals must be handled and sanitized by biosafety laws so that they can perform their main objective without posing a risk of microbial contamination for themselves, patients, and the community.

CONCLUSION

This study consolidates to foster a widespread discussion about the role of lab coats and stethoscopes in the propagation of intra-hospital microorganisms to a community and from patient to patient. It has been found that the stethoscopes and lab coats of all health professionals contained microbial contamination, in addition to some multi-resistant antibiotic strains.

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Not applicable.

ETHICS APPROVAL

This study was analyzed and approved by the Research Ethics Committee according to a substantiated opinion number 2.506.752, and obtaining the Informed Consent Form according to CNS/CONEP Resolution 466/12. The health professional who agreed to participate in the research signed both copies of the Free and Informed Consent Term and provided the lab coat and stethoscope.

Informed Consent: The patient signed the consent form.

Data Sharing Statement: No additional data are available.

Conflict of Interest: The authors declare no conflict of interest.

Similarity Check: It was applied by Ithenticate[@].

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