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Bacterial Contamination on the First-Year Internal Medicine Residents' Scrubs at H. Adam Malik Medan General Hospital.

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ABSTRACT

Background: The doctor's white coat was known to be a source of nosocomial infection. Despite many studies' results have shown the presence of bacterial contamination on the doctor's white coat, there was little research about bacterial contamination on the doctor's scrub. This study aims to investigate bacterial contamination on the scrubs of first-year residents of the Internal Medicine Department worn for one shift (17 hours).

Method: This is a descriptive study on the first-year residents' scrubs which was conducted in January - February 2021 at H. Adam Malik Medan General Hospital. Samples were taken from the sleeves and pockets of the scrubs and programmed software was used to identify the amount, percentage of bacterial contamination, and bacterial species. Data were analyzed using the SPPS version 21.

Result: Of the 31 first-year residents' scrubs that met the inclusion criteria, 79 colonies (50.6%) of bacterial contamination was found on the sleeves, and 77 colonies (49.4%) in the pockets of the scrubs. Bacteria found on the scrubs are coagulase-negative Staphylococcus, Bacillus sp., Staphylococcus aureus, Acinetobacter lwoffli, Pantoea sp., Acinetobacter baumanii, Klebsiella pneumoniae, Oligella ureolytica, and Pseudomonas stutzeri with the most common bacterial colonies found both in sleeves and pockets were coagulase-negative Staphylococcus (220.935 ± 180.56 and 289.09 ± 181.57).

Conclusion: Bacterial contamination was found mainly on the sleeves of the scrubs with coagulase-negative Staphylococcus as the most contaminating bacteria and this should be taken into consideration as this strain could cause severe infection, especially in immunocompromised patients.

Keywords: Bacterial contamination, scrubs, nosocomial infection.

ABSTRAK

***Latar Belakang**: Jas putih dokter dikenal sebagai sumber infeksi nosokomial. Meskipun banyak hasil penelitian telah menunjukkan adanya kontaminasi bakteri pada jas putih dokter, ada sedikit penelitian tentang kontaminasi bakteri pada scrub dokter. Penelitian ini*

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bertujuan untuk menyelidiki kontaminasi bakteri pada scrub residen yang dipakai selama satu shift (17 jam) di Departemen Penyakit Dalam

***Metode**: Ini adalah studi deskriptif pada penghuni tahun pertama yang dilakukan pada bulan Januari - Februari 2021 di Rumah Sakit Umum H. Adam Malik Medan. Sampel diambil dari lengan dan kantong scrub dan perangkat lunak yang diprogram digunakan untuk mengidentifikasi jumlah, persentase kontaminasi bakteri, dan spesies bakteri. Data dianalisis menggunakan SPPS versi 21.*

***Hasil:** Dari 31 scrub pada tahun pertama residen yang memenuhi kriteria inklusi, 79 koloni (50,6%) kontaminasi bakteri ditemukan di lengan, dan 77 koloni (49,4%) di kantong scrub. Bakteri yang ditemukan pada scrub adalah Staphylococcus koagulase-negatif, Bacillus sp., Staphylococcus aureus, Acinetobacter lwoffli, Pantoea sp., Acinetobacter baumanii, Klebsiella pneumoniae, Oligella ureolytica, dan Pseudomonas stutzeri dengan koloni bakteri yang paling umum ditemukan baik di lengan dan saku adalah Staphylococcus koagulase-negatif (220,935 ± 180,56 dan 289,09 ± 181,57).*

***Kesimpulan:** Kontaminasi bakteri ditemukan terutama pada lengan scrub dengan Staphylococcus koagulase-negatif sebagai bakteri yang paling terkontaminasi dan ini harus dipertimbangkan karena strain ini dapat menyebabkan infeksi parah, terutama pada pasien immunocompromised.*

***Kata kunci**: Kontaminasi bakteri, scrub, infeksi nosokomial.*

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1 Introduction

Healthcare-associated infections (HAIs) are the most frequent adverse events in healthcare delivery. It has been estimated that globally hundreds of millions of patients are affected by HAIs each year leading to unnecessary mortality and economic burden to healthcare systems, patients, and their families. Around 7% and 10% of hospitalized patients at any given time acquire at least one HAI in developed and developing countries, respectively [1]. The impact of HAIs is more severe in resource-limited settings where the rate of infection is estimated to range from 25% to 40%.[2,3] Patients shed infectious microorganisms into the healthcare environment, and healthcare workers acquire these organisms, thereby transmitting the microorganisms further.[4] With the increasing prevalence of multidrug-resistant (MDR) bacteria in hospital settings, investigation of the role of environmental factors including medical professionals' attire in the spread of infection is important.[5] Medical professionals' white coat is associated with humanism and standard of professionalism.[6] It is a symbol of hope and healing for medical professionals. At the same time, the bitter irony is white coats are also known to harbor pathogenic bacteria transiently, thus transmitting the microbes in the hospital environment and also predisposing to the patient-to-patient transmission of infections.[7,8] Although studies have not directly linked healthcare workers' apparel to HAIs, different research groups have found

that white coats are often colonized with pathogenic bacteria including methicillin-resistant Staphylococcus aureus (MRSA) and vancomycin-resistant enterococci (VRE).[9,10] Among health workers, nurses are the ones who come in direct contact with patients during treatment and care. It has been suggested that nurses' uniform is the missing link in breaking the chain of HAIs.[11]

Nosocomial infection is an infection acquired within 48 hours or more after hospital admission or within 30 days after discharge following in-patient care.[12] Doctors' white coats asone of many sources of nosocomial infection play an important role in the transmission of bacteria from infectious patients to others. Doctors frequently wear white coats outside of hospitalsettings, for example in canteens, supermarkets, libraries, and even in worship places. This attitude can increase the probability of bacterial contamination either pathogenic or non-pathogenic strain on the white coat.[13,14] Previous studies had indicated that there was bacterial contamination on the doctors' white coats.[15-17]

However, there has been little research regarding bacterial contamination in doctors' scrubs. This study aims to determine bacterial contamination on the scrubs worn for one shift (17 hours) by the first-year residents of the Internal Medicine Department at H. Adam Malik Medan General Hospital. The study was also focused to investigate if the white coats are contaminated with any potentially pathogenic bacteria.

2 Method

This is a descriptive study on the first-year residents' scrubs of the Internal Medicine Department which was conducted in January-February 2021 at H. Adam Malik Medan General Hospital with the approval of the USU Faculty of Medicine Research Ethics Commission. Subjects enrolled in this study had signed the informed consent that they had been given sufficient information about the research. At the end of the shift (8 A.M.) every Monday till Friday, subjects were brought to the Microbiology laboratory and the laboratory staff will collect samples from the sleeves and pockets of the scrubs by swab method. Nutrient agar, nutrient broth, MacConkey agar, and blood agar were used as media to assess bacterial growth, and then the media were incubated in a 37 degrees Celcius incubator for 24 hours. Bacterial growthwas counted as a Colonies Forming Unit (CFU). Gram staining was performed after culture andprogrammed software was used as a tool to analyze bacterial species, amount, and percentageof bacterial contamination on the scrubs.

3 Results

Thirty-one first-year residents were enrolled in the study with male to female-subject ratio was 13:18 (58.1% v.s. 41.9%). All subjects were right-handed so the swabs were taken from the right sleeves and right pockets of the scrubs. A total of 156 colonies of bacteria were identifiedand the majority of bacterial contamination was on the sleeves (Table 1).

Table 1 Amount of bacterial contamination on the sample collection site

Sample collection	Bacterial Contamination	
	n	%
Pockets	77	49.4
Sleeves	79	50.6

Based on Table 2, bacteria identified in this study were coagulase-negative Staphylococcus, Bacillus sp., Staphylococcus aureus, Acinetobacter lwoffli, Pantoea sp., Acinetobacter baumanii, Klebsiellapneumoniae, Oligella ureolytica, and Pseudomonas stutzeri (Table 2).

Table 2 Comparison of bacterial contamination on the sleeves and pockets

Bacterial species	**Contamination site**		**Total**
	Pockets (n,%)	Sleeves (n,%)	(n,%)
Coagulase-negative Staphylococcus	31(40.3)	31(39.2)	62(39.7)
Bacillus sp.	28(36.4)	30(38.0)	58(37.2)
Staphylococcus aureus	7(9.1)	5(6.3)	12(7.7)
Acinetobacter woffli	8(10.4)	9(11.4)	17(10.9)
Pantoea sp.	0(0.0)	2(2.5)	2(1.3)
Acinetobacter baumanii	1(1.3)	1(1.3)	2(1.3)
Klebsiella pneumoniae	1(1.3)	0(0.0)	1 (0.6)
Oligella ureolytica	0 (0.0)	1 (1.3)	1(0.6)
Pseudomonas stutzeri	1 (1.3)	0 (0.0)	1(0.6)

Bacillus sp. was the only non-pathogenic bacteria found in this study. The main bacterial contamination on the pockets was coagulase-negative Staphylococcus, followed by Klebsiella pneumoniae and Staphylococcus aureus (220.935±180.56; 107; and 28.85±37.76 CFU/mL, respectively). Coagulase-negative Staphylococcus was also the most colonies found on the sleeves, followed by Staphylococcus aureus and Oligella ureolytica (289.09±181.57; 24.60±41.50; 23 CFU/mL, respectively) (Table 3).

Table 3 Amount of Bacterial Colonization on The Sleeves and Pockets

Bacterial Species	Colonies (CFU/ml)	
	Pockets	Sleeves
Coagulase-negative Staphylococcus	220.935±180.56	289.09±181.57
Bacillus sp.	10.78±9.97	15.90±12.49
Staphylococcus aureus	28.85±37.76	24.60±41.50
Acinetobacter lwoffli	10.25±5.41	11.88±10.72
Pantoea sp.	0	9.55±2.12
Acinetobacter baumanii	21	10
Klebsiella pneumoniae (ESBL+)	107	0
Oligella ureolytica	0	23
Pseudomonas stutzeri	10	0

4 Discussion

Doctors' scrubs might play an essential role in the transmission of microorganisms in both in-hospital and out-hospital environments. Transmission of infection among patients in healthcare facilities has been associated with the temporary attachment of pathogens on scrubs.[18,19] In our study, there was bacterial contamination in the pockets and sleeves of the scrubs with the majority of bacterial colonization on the sleeves (50.6%). A previous study had reported a significant increase in the rate of contamination of the white coats and scrubs worn for one shift. Treakle et al. found that 34 out of 149 (23%) white coats of attendees of medical and surgical grand rounds at a large teaching hospital were contaminated with Staphylococcus aureus.[8] Thom's study reported 217 out of 720 (30.1%) scrubs were colonized by pathogenic bacteria after being worn for one shift in the hospital.[20]

In our study, the number of bacteria identified on the sleeves was higher than those on the pockets, with coagulase-negative Staphylococcus, Bacillus sp., and Acinetobacter lwoffli being the most identified bacteria (39.7%, 37.2%, and 10.9%, respectively). Humairoh et al. also reported bacteria contamination (Bacillus sp., Streptococcus sp., Staphylococcus sp., and Staphylococcus aureus) on dentists' coats at Baiturrahman Hospital during scaling procedures.[21] Previous studies had consistently reported that doctors' white coats were contaminated with approximately 28.46% to 95% of bacteria. In a study by Wong et al., the bacterial contamination on the white coats was from skin commensal bacteria such as coagulase-negative Staphylococcus, and no presence of pathogenic bacteria was found.[22] Although coagulase-negative Staphylococcus are commensal bacteria that colonize the skin and was considered harmless, they can also cause bacteremia, especially in the intensive care unit, elderly patients, and immunocompromised patients.[23] Bacillus sp. as the second most common bacteria found in this study, could induce local and systemic infections and cause septicemia, endophthalmitis, pneumonia, endocarditis, meningitis, and encephalitis, especially in immunocompromised patients such as neonates.[24]

Coagulase-negative Staphylococcus, Staphylococcus aureus, and Oligella ureolytica were among the most identified bacteria colonies in the sleeves while in the pockets, coagulase-negative

Staphylococcus, Klebsiella pneumoniae, and Staphylococcus aureus were the dominant bacteria. Yora's study also identified 17 isolates (56.7%) of Staphylococcus aureus among 30 samples of doctors' white coats and one of these isolates was proven to be MRSA (3.3%).[25] Krueger's study showed that all of the Staphylococcus aureus identified in residents' white coats were methicillin-susceptible Staphylococcus aureus (MSSA).[26] A study by Sianturi et al. in the neonatal care unit of the H. Adam Malik Medan General Hospital showed that Staphylococcus sp. was the most common cause of sepsis in neonates (32.3%) followed by Pseudomonas sp. and Enterobacter sp.[27] Staphylococcus aureus contamination was frequently found in white coats worn by doctors who work in the inpatient setting. The white coats of surgeons were more likely to contain Staphylococcus aureus than the coats of other specialists.[19] MRSA could be transmitted through direct contact, open wound,s and contaminated hands andcould cause sepsis, pneumonia, endocarditis, skin and soft tissue infection (SSTI,) and infection at the surgical site. MRSA infection in neonates could cause prematurity and low birth weight.[24] Meanwhile, in our hospital, MRSA is one of the contributors of multidrug resistance organisms during January-December 2020 with quite a high rate (56%), together with Escherichia coli ESBL (78%) and Klebsiella pneumoniae ESBL (75%).[28] Among the 149 grand rounds attendees' white coats, 34 (23%) were contaminated with S aureus, of which 6 (18%) were MRSA. None of the coats was contaminated with VRE. S aureus contamination was more prevalent in residents, those working in inpatient settings, and those who saw an inpatient that day.[29]

Fifty percent of the sampled swatches were found to be contaminated by pathogenic bacteria. the average colony growth per square inch of the patch was 524 and 857 during the first and second workdays, respectively, indicating an increase of 63.6% in colony counts. The pathogens detected on patches were Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, and Acinetobacter sp. Additional bacteria identified included Bacillus sp., Micrococcus sp., and coagulase-negative staphylococci (CoNS). The nurses working in the maternity department had their white coats highly contaminated with bacteria. On the other hand, the least bacterial contamination was recorded from the nurses of the surgery ward. One S. aureus isolates from the maternity ward was resistant to methicillin. This study showed that pathogens belonging to the WHO list of critical priority and high priority have been isolated from the white coats of nurses, thus posing the risk of transmission to patients. White coats must be worn, maintained, and washed properly to reduce bacterial contamination load and to prevent cross-contamination of potential superbugs. The practice of wearing white coats outside the healthcare zone should be strictly discouraged.[30]

Twenty-two articles were included: 16 (73%) cross-sectional studies, 4 (18%) randomized controlled trials, and 2 (9%) cohort studies. Results are organized by microbial contaminants, antibiotic resistance, types of providers, fabric type, antimicrobial coating, and laundering practices. Provider attire was commonly colonized by MDROs, with white coats laundered less

frequently than scrubs. Studies revealed considerable differences among fabrics used and laundering practices.

The limitations of our study were that we did not perform an antimicrobial susceptibility test on Staphylococcus aureus to determine whether the strain was MRSA or MSSA and there was no statistical analysis to determine whether the bacteria contamination was significant or insignificant about the rate of nosocomial infection. We suggested that there is a need for further studies with a different methodology

5 Conclusions

Findings suggest that provider attire is a potential source of pathogenic bacterial transmission in healthcare settings. However, data confirming a direct link between provider attire and healthcare-associated infections remain limited. Suggestions outlined in this article may serve as a guideline to reduce the spread of bacterial pathogens, including MDROs, that have the potential to precipitate hospital-acquired infections.[31]

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