Bacterial Profile of Nurses' Uniforms: A Descriptive Cross-sectional Study

Jonathan Bayuo (jbayuo88@gmail.com)
Presbyterian University College- Ghana Faculty of Health and Medical Sciences Department of Nursing
Emmanuel Obour
Presbyterian University College
Felix Bonsu
Malaria Research Laboratory, Agogo Presbyterian Hospital
Frank Agyei
Presbyterian University College
Akua Asante
Presbyterian University College
Doreen Abeasi
Presbyterian University College
Samuel Akyem
Presbyterian University College
Stephen Nabaale
Presbyterian University College

Research Article

Keywords: Bacteria, Nurses, Uniforms

Posted Date: December 17th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-127402/v1

Abstract

Background: The bacterial profile associated with nurses' uniforms have not been empirically ascertained within the Ghanaian setting.

Objective: To evaluate the bacterial profile of scrubs worn by nurses over a 24-hour period.

Methods: A descriptive cross-sectional approach was used with 20 conveniently recruited Registered Nurses spread across a 24-hour shift period. Sterile scrubs were provided and at the end each shift, four zones were swabbed (axilla, anterior trunk, posterior trunk, and posterior aspects of the trousers). The laboratory isolation processes proceeded through colony identification, gram staining, catalase test (Gram-positive), lactose fermenter (Gram-negative), Triple Sugar Iron and Motility Indole Ornithine (Enterobacteria).

Results: Both Gram-negative and Gram-positive bacteria were identified which may suggest that irrespective of the unit in which nurses worked, their uniforms served as surfaces of bacterial habitation. At least, one organism was isolated at all the areas swabbed suggesting that nurses' uniforms are contaminated at the end of their shift.

Conclusion: The findings suggest a need for collective efforts to ensure that uniforms are not worn beyond the confines of the healthcare setting as well as strict adherence to infection prevention and control policies within the hospital.

Background

Hospital-acquired infection (HAI) is a major problem resulting in significant mortality, morbidity, and financial burden globally. The risk of HAI in developing countries is approximately twenty times higher than in developed countries with the uniforms of healthcare professionals playing an important role in the high prevalence of HAI (1). The uniforms are deemed as a surface for microorganism habitation/ growth, which can then serve as a medium to facilitate the transmission process within the hospital premises (2). The pathogens may also get into public domain if the use of uniforms is not properly regulated beyond the confines of the healthcare setting. The nature of clinical nurses' work suggests continuous contact with patient, family members and the hospital environment. As a result, heavy contamination of pathogenic microorganisms may occur during any shift (3). Uniforms may therefore act as reservoirs and play a role in bacteria transmission. A laboratory analysis after 48 hours of nurses using their uniforms showed growth of methicillin-resistant *Staphylococcus aureus* (MRSA), *Bacillusspp.*, *Micrococcus luteus*, *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Micrococcus roseus* (4). Similarly, other studies have confirmed the presence of pathogens such as *Clostridium difficile* (5); *Staphylococcus aureus* and *vancomycin-resistant enterococci* (VRE) (6); *Staphylococcus aureus*, *Acinetobacter baumannii*, *Klebsiella pneumoniae* and *Serratia rubida* on the uniforms of nurses following completion of a shift (7).

Further to the above, a relationship between the presence of pathogens such as MRSA and *vancomycin-resistant Enterococci* (VRE) on health care providers' uniforms and the spread of nosocomial infection has been reported (6). In fact, up to 60% of hospital staff's uniforms have been observed to be colonized with potentially pathogenic bacteria, including drug-resistant organisms at abdominal zone, sleeve ends, and pockets (8). Even after utilizing scrubs with antimicrobial properties, bacterial contamination may still occur at the end of a nursing shift (9, 10). Despite the reality of uniform contamination, it is possible healthcare staff may consider their uniforms to be clean simply because there are no visible stains or spots and use these uniforms in the public setting (11, 12). Consequently, it raises public health concerns and the risks need to be properly addressed (13).

Countries such as the United Kingdom, Belgium, Australia, and Canada recognize and address the problem by discouraging the wearing of hospital clothing outside the workplace and the hospitals may be expected to provide sterile uniforms so as to control nosocomial infection (4). However, in Ghana, the regulation that controls the wearing of uniforms among healthcare professionals particularly in public remains yet to be fully enforced. Although the National Policy and Guidelines for Infection Prevention and Control in Health Care Settings which was developed in 2015 stipulate that staff should change their street clothes/ uniforms on arrival at the health facility (14), anecdotal evidence suggest that this does not happen in all settings. Besides, some nurses' wear their uniforms to public places such as markets, and food vending sites. On some occasions, nurses who double as nursing mothers maybe seen in their uniforms with their babies stuck at their back. Also, it is common to come across nurses in their uniforms stuck in a public transport in close contact with other passengers onboard, on their return from work. Although this issue may appear to be overlooked, a recent feature article published in Modern Ghana has reiterated similar concerns describing the phenomenon as a major public health concern that needs to be addressed immediately (15). Despite these concerns, there has been no empirical evaluation to identify the organisms these uniforms may be contaminated with. Thus, the risks these uniforms pose are unclear within the Ghanaian setting though they could be major sources of spreading pathogens. To assist policy makers and to safeguard the health of the general populace, patients, and the healthcare staff, it is essential to know the bacterial profile of these uniforms within our setting. Thus, this study sought to evaluate the bacterial profile of clinical nurses' uniforms with the following objectives: to ascertain the bacteria profile on the uniforms at the end of a shift, to examine if particular bacteria strains were related to particular units in the hospital or nursing shift period and to assess which areas of the uniform enhanced bacterial habitation/ survival focusing on four areas: axilla, anterior trunk, posterior trunk and posterior aspects of the trousers.

Methods

Design

The study utilised a descriptive cross-sectional approach with twenty (20) nurses over a 24-hour shift. Four (4) samples were obtained from each participant adding up to 80 samples at the end of study.

Setting

The study was conducted at the Agogo Presbyterian hospital in the Ashanti-Akyem North District of Ghana. The hospital has grown to become the second largest hospital in the Ashanti Region of Ghana, a referral center for many hospitals far and near. The specialized care provided include surgery, ophthalmology, pediatrics, obstetrics and gynecology and it attracts patients from all parts of Ghana and nearby countries like Burkina Faso, Togo, and La Cote d'Ivoire. The nursing strength of the facility as at the period the study was undertaken was 103. Four units were randomly selected for the study: Emergency Department, Intensive Care Unit, Medical and Surgical Wards.

Study Process

The study proceeded through 3 phases:

Phase One (Preparatory): Introductory letters were obtained from the affiliate university and ethical approval obtained from the hospital. Scrubs were obtained from participants, washed, and packed in drums to the Central Sterilization and Supply Department (CSSD) for sterilization. This phase also involved obtaining required laboratory consumables for the study. Convenience sampling approach was used to recruit nurses from the Emergency Department, Intensive Care Unit (ICU), Medical and Surgical Wards. Twenty (20) nurses participated in the study with five (5) nurses recruited from each of the units stated above. The nurses recruited were on morning (6 hour), afternoon (6 hour) and night (12 hour) shifts.

Phase Two: A short questionnaire was completed to capture socio-demographic characteristics of the participants. Participants were required to wash their hands thoroughly up to the elbow level with carbolic soap under running water for a minimum of 20 seconds. Following this, they donned surgical gloves before been handed the scrubs which had been retrieved from the CSSD at the start of the shift and kept in a sterile drum. A member of the research team ensured that they did not touch any item thereafter and provided escort to the changing room/ site available in the ward. At the end of the shift, four areas of the scrubs (the axilla, anterior trunk, posterior trunk, and posterior aspects of the trousers) were swabbed whilst being worn by the participant. A sterile swab which had been dipped in sterile normal saline previously was used to obtain all samples following which the nurse could take off the scrub. The samples were obtained by a member of the research team who had received prior training on best practices. All the samples were labeled and transported immediately to the laboratory located within the hospital premises by the same research team member who obtained the samples.

Phase Three: This phase involved laboratory investigations to isolate the organisms. The following media were prepared under controlled conditions: MacConkey Agar, Blood Agar, Triple Sugar and Motility Indole Ornithine (MIO) medium. Every material, equipment and procedures were aseptically controlled. All pre-analytical, analytical, and post-analytical stages of the quality of assurance, which were in place in the laboratory, were strictly followed. After completion of media preparation, quality control was done by incubating at room temperature, 37^{o}C and using American Type Culture Collection (ATCC) samples for 18-24 hours. The blood agar and MacConkey were cultured with *Staph. aureus* and *E. coli* respectively and the Media were incubated at room temperature. At 37^{o}C it showed no bacteria growth but the one with ATCC spp. showed significant growth which indicates that the media supported growth and could be used for the study. The laboratory investigation followed the following protocol:

1. If there is growth on Blood agar and MacConkey agar perform colony identification
2. Perform Gram staining on them which will give you a gram reaction either positive or negative
3. If Gram positive, perform catalase test to identify if the organism is catalase positive or negative.
4. If the organism is catalase positive, perform coagulase test to differentiate Staphylococcus and Streptococcus spp.
5. If Gram negative, perform lactose fermenter to ascertain whether they are lactose fermenter or non- lactose fermenter
6. If fermenter perform Triple Sugar Iron (TSI), Motility Indole Ornithine (MIO) and Enterobacteria identification on them.
7. If non-fermenter, perform oxidase test + Triple Sugar Iron + Enterobacteria identification

Results

Socio-demographic Characteristics

Twenty (20) nurses participated in the study with four (4) sites swabbed for each participant. Table 1 presents the socio-demographic characteristics of the participants.

Table 1: Socio-demographic characteristics of participants

Characteristic		n= 20
Age	26-30	12
	31-35	4
	36-40	4
Gender	Male	10
	Female	10
Number of years worked	<1 year	4
	2-5 years	14
	6-10 years	2
Shift	Morning	8
	Afternoon	8
	Night	4
Ward	Medical Ward	5
	Emergency	5
	Surgical Ward	5
	ICU	5

Bacteria Profile at the end of Shift

The results of the investigation are presented as Table 2. Gram negative and Gram-positive bacteria were isolated at the end of various shifts. *Staph albus* (coagulase negative staphylococcus) was the main organism isolated from the scrubs of participants on the morning shift with occasional isolation of *E. Coli*, *Klebsiella spp* and *Pseudomonas fluorescens*. The afternoon samples revealed strains of *Pseudomonas, Morganella morganii, Plesiomonas, Chromobacterium violaceum and Citrobactor youngae* in addition to *Staph Albus*. The samples obtained over the night shift also showed similar trend of organisms as observed in the morning samples.

Bacteria strains in relation to hospital Units and nursing shift

As shown in Table 2, various strains bacteria were identified across hospital wards and nursing shifts. *Staph Albus* (coagulase negative staphylococcus) and *Klebsiella spp* emerged as bacteria strains across shifts and wards. In addition to these strains of bacteria, *Pseudomonas orzihabitans, Morganella morganii, Pseudomonas fluorescens, Plesiomonas shegelloides*, *Citrobactor youngae* and *Salmonella spp* were identified from the samples obtained from the Surgical ward during the afternoon shift on anterior trunk, posterior trunk, and trousers. Also, *Chromobacterium violaceum* and *Pseudomonas aeruginosa* were identified from the ICU samples obtained during the afternoon shift. Further to the above, *E coli* and *Klebsiella spp* emerged from the axilla region of the Emergency department, ICU, and medical ward from the night shift samples.

Areas of uniform that enhanced bacteria habitation

From the results of the laboratory investigation shown in Table 2, it is evident that all aspects of the uniform swapped promoted bacteria habitation/ survival. This is because at least one strain of bacteria was noted at all areas swabbed. Assessing the bacteria load at these areas was however beyond the scope of this current study.

Table 2: ***Isolated Organisms***

	MORNING SHIFT				AFTERNOON SHIFT				NIGHT SH
	AXILLA	ANT. TRUNK	POST. TRUNK	TROUSERS	AXILLA	ANT. TRUNK	POST. TRUNK	TROUSERS	AXILLA
Medical Ward	*Staph albus; Klebsiella spp.*	*Staph. albus; Pseudomonas fluorescens*	*Staph. albus*	*Staph. albus; Klebsiella spp*	*Staph albus*	*Staph albus*	*Staph albus*	*Staph albus*	
	Staph albus; Klebsiella spp.	*Staph albus*	*Klebsiella spp.; Staph albus*	*Staph albus; Klebsiella spp; E. coli*	*Staph albus*	*Staph albus*	*Staph albus; Klebsiella spp*	*Staph albus*	
Emergency Department	*Staph albus; Klebsiella spp*	*Staph albus*	*Staph albus; Pseudomonas fluorescens*	*Staph albus*	*Staph albus*	*Staph albus; Klebsiella spp*	*Staph albus*	*Staph albus*	
	Staph albus	*Staph albus; Pseudomonas fluorescens*	*Staph albus; Klebsiella spp*	*Staph albus*	*Staph albus*	*Staph albus; Klebsiella spp*	*Staph albus; Klebsiella spp*	*Staph albus*	*E. Coli; Staph albus*
Surgical Ward	*Staph albus; Klebsiella spp*	*Klebsiella spp; Staph albus*	*Staph albus*	*Staph albus; Klebsiella spp*	*Staph albus*	*Pseudomonas orzihabitans; Staph albus*	*Morganella morganii; Staph albus*	*Salmonella spp; Staph albus*	*Staph albus*
	Staph albus	*Staph albus*	*Staph albus; Pseudomonas fluorescens*	*Staph albus*	*Staph albus Klebsiella spp*	*Pseudomonas fluorescens*	*Plesiomonas shegelloides*	*Citrobactor youngae; Staph albus*	
Intensive Care Unit	*Staph albus*	*Staph albus; Pseudomonas fluorescens*	*Staph albus*	*Staph albus*	*Staph albus*	*Staph albus*	*Staph albus; Klebsiella spp*	*Staph albus*	*Staph albus; Klebsiella spp*
	Staph albus	*Staph albus*	*Staph albus; Klebsiella spp*	*Staph albus*	*E. Coli; Staph albus*	*Staph albus; Klebsiella spp*	*Chromobacterium violaceum; P. Aeruginosa spp.; Staph albus*	*P. Aeruginosa spp.; Staph albus*	

Discussion

The study sought to ascertain the bacteria profile of nurses' uniforms at the end of a shift, bacteria strains related to specific clinical units or nursing shift and to assess which areas of the uniform enhanced bacterial habitation/ survival (axilla, anterior trunk, posterior trunk, and posterior aspects of the trousers). The study findings suggest that various strains of bacteria are present on various parts of nurses' uniforms at the end of a shift, irrespective of the unit in which they worked. Although the bacterial load may differ, contamination of the uniforms by bacteria may not necessarily be related to the number of hours worked as bacteria strains isolated from samples obtained over the night shift (12 hours) were like those obtained during the 6-hour morning/ afternoon shift. Additionally, at least a strain of bacteria was identified from all swabbed areas suggesting that all parts of the uniform may enhance bacterial habitation/ survival. Taken together, the study findings suggest that nurses' uniforms are contaminated at the end of a shift and its usage beyond the confines of the healthcare setting should be discouraged.

Uniforms of health care workers provide a surface for microbial habitation which can spread from one person to the other: thus facilitating the occurrence of HAI (2). In similar lines, the current study identified that all surfaces swapped (axilla, anterior trunk, posterior trunk, and trousers) were surfaces that facilitated bacteria habitation. Although the pattern and risk of spread were not examined in the current study, nurses' uniforms may be considered contaminated at the end of a shift irrespective of the unit in which they work (3). Previous studies in other settings have confirmed the presence of various organisms such as *Staphylococcus aureus, Enterobacter aerogenes*, *Streptococci spp,* Methicillin-resistant *Staphylococcus aureus,* Vancomycin-resistant *enterococci*, *and Clostridium difficile* on white lab coats worn by health professionals (5, 16). These findings reiterate the assertion by the Occupational Safety and Health Administration (OSHA) that nurses' uniforms get contaminated during a shift and do not require appearance in public. This raises concerns regarding Ghanaian nurses who wear their uniforms to public places such as food vending or even carry their babies after close of work. There is a need to remind staff of the presence of potential pathogens on uniforms at the end of every shift to ensure adherence to best practices. For example, nurses can be encouraged to come to work in their own clothes and changeover to scrubs for working as enshrined in of the National Policy and Guidelines for Infection Prevention and Control in Health Care Settings (sub-section 2.14, p.11). Also, the use of a single scrub/ uniform for successive shifts may be problematic as bacteria may accumulate over the period of usage. Thus, healthcare managers may need to ensure the constant supply freshly laundered scrubs for all staff across wards and shifts. Additionally, healthcare managers need to provide changing rooms and if possible, shower facilities to ensure that the movement of pathogens beyond the hospital are reduced to the minimum.

Though the current study did not ascertain the bacteria load at the various sites, the findings suggest that there is a need to have a mechanism in place to ensure that scrubs are not taken home but to the laundry and new/ fresh ones obtained for the next shift. As suggested by Belkin, under no circumstance should a contaminated scrub/ uniform be taken home for decontamination (17). Resources will need to be made available as the harm caused by these pathogens may be more than resources required to prevent their spread. Additionally, the health care facilities need to take charge of properly laundering the

scrubs after a shift. As Parish asserts, hospitals and other health organizations cannot monitor the home washing practices of all staff and therefore have no way to prevent this problem (18). The Center for Disease Control (CDC) recommends the use of temperature of 71.1 degrees Celsius (approx. 160 degrees Fahrenheit) for a minimum of twenty-five minutes to adequately decontaminate the uniforms and this may be obtainable in the hospitals.

Coagulase negative staphylococcus *Staph albus and Klebsiella spp* appeared to be the most predominant organisms isolated throughout the 24-hour period in the current study. However, further tests could not be carried out to assess the specific strains of *Staphylococcus* due to limited funding. Although *Staph albus and Klebsiella spp* maybe considered a part of the normal flora of the human skin which may have been transported to the scrubs as nurses wore them during the study, they are potentially harmful to patients. Recent studies suggest that these strains of bacteria can lead to severe cases of bacteremia although they are considered normal flora elsewhere (19, 20). The finding suggests that even after wearing freshly laundered scrubs/ uniforms, there is still a need for other precautions such as use of aprons to minimise the occurrence of hospital-acquired infections.

Previous studies have reported the existence of *Enterococci* strains on the uniforms of health care providers, but these studies were unable to identify the exact strains that existed (6, 16). In the current study, specific strains of Enterobacteriaceae (*Morganella morganii, Citrobactor youngae),* Vibrionaceae (*Plesiomonas shegelloides),* Neisseriaceae (*Chromobacterium violaceum)* and Pseudomonadaceae (*Pseudomonas orzihabitans, Pseudomonas fluorescens, Pseudomonas aeruginosa)* were isolated. These are gram-negative organisms that could result in fatal cases of septicemia (21-23) and peritonitis (24). Organisms such as *Pseudomonas orzihabitans, Chromobacterium violaceum* and *Pseudomonas fluorescens* are normal flora of the soil. Considering that the setting of the study is predominantly a farming community suggests that health workers' interactions with family members/ visitors during the afternoon shift (visiting hours) could have potentially led to the transmission of the organisms. The finding suggests a need for further precautions such as developing screening procedures for visitors or allowing visitors to gown before seeing a patient.

According to one study in which three sites namely the mouth of the pocket, abdominal area and the sleeves were swabbed, the authors noted the existence of varying strains of bacteria (25). Sande and colleague have reported that the rate of contamination was higher on pockets (57.4%) compared with the abdominal area (27.6%) and the sleeve ends (14.8) (26). Despite this, another study observed that the abdominal area of a uniform is considered the highest contaminated area (1). Despite the mixed findings, such conclusion is beyond the scope of the current study as it only identified the organisms but not the bacterial load. Future studies in the Ghanaian setting will therefore need to go a step further to identify the bacterial load to identify areas that favor bacteria habitation/ survival more than other sites.

Though the study findings are comparable to evidence from other studies, some limitations are noteworthy. Firstly, it was not possible to restrict the movement of participants and as such it will be difficult to strongly link the organisms to specific units in the hospital. Additionally, it was impossible to undertake further tests to identify the specific strains of *Staphylococcus* as well as the bacterial load though further tests were completed to identify the Gram-negative strains. Also, although steps were taken to protect the scrubs whilst being worn by the participants, it is possible the surface of these scrubs may have still touched some body parts of the participants. Though all the sites swabbed showed the presence of bacteria, it is possible the load may differ, and this could be focus of future studies.

Conclusion

Nurses' uniforms are contaminated with various strains of bacteria after close of work. Thus, collective effort is needed to minimise the wearing these uniforms beyond the confines of the healthcare setting and there should be strict adherence to aseptic measures in the healthcare facility.

Declarations

Ethical approval: The study was approved by the Agogo Presbyterian Hospital prior to commencement. Informed consent was sought from all participants prior to inclusion in the study. All methods were also carried out in **accordance with relevant guidelines and regulations.**

Consent for publication: Not applicable

Availability of data and materials: The datasets used and/ or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: All authors declare no competing interests

Funding: The study received no funding

Authors' contributions: JB, EO and FOB conceptualised the study; recruitment, protocol design and data collection were carried out by JB, EO, FOB, FBA, AOA, SOA; all authors undertook literature search, data analysis, write-up, critical review, and approval of the manuscript.

Acknowledgement: The authors wish to thank the staff of the hospital for their support in the conduct of the study.

References

1. Abu Radwan M, Ahmad M. The microorganisms on nurses' and health care workers' uniforms in the intensive care units. Clinical Nursing Research. 2019;28(1):94-106.
2. Pinon A, Gachet J, Alexandre V, Decherf S, Vialette M. Microbiological contamination of bed linen and staff uniforms in a hospital. Advances in Microbiology. 2013;2013.

3. Oliveira ACd, Silva MdDM, Garbaccio JL. Clothing of health care professional as potential reservoirs of micro-organisms: an integrative review. Texto & Contexto-Enfermagem. 2012;21(3):684-91.
4. Sanon M-A, Watkins S. Nurses' uniforms: How many bacteria do they carry after one shift? Journal of public health and epidemiology. 2012;4(10):311.
5. Perry C, Marshall R, Jones E. Bacterial contamination of uniforms. Journal of Hospital Infection. 2001;48(3):238-41.
6. Treakle AM, Thom KA, Furuno JP, Strauss SM, Harris AD, Perencevich EN. Bacterial contamination of health care workers' white coats. American journal of infection control. 2009;37(2):101-5.
7. Pilonetto M, Rosa EAR, Brofman PRS, Baggio D, Calvário F, Schelp C, et al. Hospital gowns as a vehicle for bacterial dissemination in an intensive care unit. Brazilian Journal of Infectious Diseases. 2004;8(3):206-10.
8. Wiener-Well Y, Galuty M, Rudensky B, Schlesinger Y, Attias D, Yinnon AM. Nursing and physician attire as possible source of nosocomial infections. American journal of infection control. 2011;39(7):555-9.
9. Anderson DJ, Addison R, Lokhnygina Y, Warren B, Sharma-Kuinkel B, Rojas LJ, et al. The antimicrobial scrub contamination and transmission (ASCOT) trial: a three-arm, blinded, randomized controlled trial with crossover design to determine the efficacy of antimicrobial-impregnated scrubs in preventing healthcare provider contamination. infection control & hospital epidemiology. 2017;38(10):1147-54.
10. Thom KA, Escobar D, Boutin MA, Zhan M, Harris AD, Johnson JK. Frequent contamination of nursing scrubs is associated with specific care activities. American journal of infection control. 2018;46(5):503-6.
11. Banu A, Anand M, Nagi N. White coats as a vehicle for bacterial dissemination. Journal of clinical and diagnostic research: JCDR. 2012;6(8):1381.
12. Krueger CA, Murray CK, Mende K, Guymon CH, Gerlinger TL. The bacterial contamination of surgical scrubs. Am J Orthop (Belle Mead NJ). 2012;41(5):E69-73.
13. Jacob G. Uniforms and workwear: an evidence base for developing local policy. NHS Department of Health Policy. 2007.
14. Health Mo. National Policy and Guidelines for Infection Prevention and Control in Health Care Settings 2015.
15. Akobrika D. Nurses' Uniforms: An Infection Reservoir. Modern Ghana 2020.
16. Moravvej Z, Fakhar Y, Naderi-Nasab M, Askari E. Study on bacteria associated with White Coats of healthcare workers in two tertiary hospitals, Mashhad, Iran. Journal of Medical Bacteriology. 2013;2(3-4):17-25.
17. Belkin NL. Home laundering of soiled surgical scrubs: surgical site infections and the home environment. American journal of infection control. 2001;29(1):58-64.
18. Parish C. Washing work clothes at home risks spreading infection, conference told. Nursing Standard. 2005;20(12):12-3.
19. Madavi D, Kumar B, Khatwar PT. Clinico-Etiological Profile of Bacterial Infections in Children with Sickle Cell Anemia. Stroke.1:0.6.
20. Sidhartha JM, Reddy LVPK, Reddy YHK, Subbaiah MV. Microbiological Study of Respiratory Tract Infections in a South Indian Hospital. Research & Reviews: A Journal of Health Professions. 2019;5(2):1-5.
21. Janda JM, Abbott SL, McIver CJ. Plesiomonas shigelloides revisited. Clinical microbiology reviews. 2016;29(2):349-74.
22. Scales BS, Dickson RP, LiPuma JJ, Huffnagle GB. Microbiology, genomics, and clinical significance of the Pseudomonas fluorescens species complex, an unappreciated colonizer of humans. Clinical microbiology reviews. 2014;27(4):927-48.
23. Singla N, Kaistha N, Gulati N, Chander J. Morganella morganii could be an important intensive care unit pathogen. Indian journal of critical care medicine: peer-reviewed, official publication of Indian Society of Critical Care Medicine. 2010;14(3):154.
24. Chen K, Chen T, Sue Y. Citrobacter youngae and Pantoea agglomerans peritonitis in a peritoneal dialysis patient. Peritoneal Dialysis International. 2013;33(3):336-7.
25. Munoz-Price LS, Arheart KL, Mills JP, Cleary T, DePascale D, Jimenez A, et al. Associations between bacterial contamination of health care workers' hands and contamination of white coats and scrubs. American journal of infection control. 2012;40(9):e245-e8.
26. Sande SV, Basak SA. White coats: how much safe are they. 2015.