Journal of
Anesthesia & Intensive Care Medicine
ISSN: 2474-7653

Juniper Publishers
key to the Researchers

Research Article
Volume 12 Issue 4 - February 2023
DOI: 10.19080/JAICM.2023.12.555842

J Anest & Inten Care Med

Determination of the Bacterial Ecology of the Intensive Care Unit of Saint Louis Regional Hospital, Senegal

Diedhiou M*, Lo S, Dieye A, Sarr N, Dia AD, Dia NM and Fall ML

Health Sciences Training and Research Unit (HSTRU), Gaston Berger University, Senegal

Submission: December 23, 2022; **Published:** February 07, 2022

***Corresponding author:** Diedhiou M, Health Sciences Training and Research Unit (HSTRU), Gaston Berger University, Saint Louis, Senegal

Summary

Introduction: This study aimed to describe the bacterial ecosystem found on surfaces and medical devices in the Multifunctional intensive care unit of the regional hospital of Saint Louis.

Materials and Methods: We conducted an observational, descriptive, and cross-sectional study in the Multifunctional Intensive Care Unit of Saint Louis Regional Hospital, Senegal. The study concerned the care environment, medical devices, and contact surfaces of care personnel. Samples were taken using sterile swabs from medical devices, surfaces, and staff.

Results: A total of 21 samples were taken. The samples were taken from the hands of staff in 66.6% of cases (n = 14), from intensive care beds in 19% of cases (n = 4), and from intensive care ventilators in 14% of cases (n = 3). A total of 8 pathogens were identified, giving a positivity rate of 38%. Klebsiella pneumonia was identified at 5 sites, representing 23.8% of cases, staphylococcus aureus at 2 sites, accounting for 9.5% of cases, and pseudomonas aeruginosa was identified at 1 site, corresponding to 4.7% of cases. Our study showed an antibiotic resistance rate of 62.5% (n=5).

Discussion/Conclusion: The pathogenic bacteria of the ecosystem of the service are at the origin of nosocomial infections, which suggests the importance of hospital environment control.

Keywords: Nosocomial Infection; Intensive Care Unit; Bacterial Ecology

Introduction

The determination of bacterial ecology is a paramount pillar in the control of nosocomial infection. The germs identified in nosocomial infections in the intensive care unit come from the care setting, medical devices and surfaces, and staff. This study aimed to identify the pathogens involved in the bacterial ecology of our department. The samples were cultured on a non-selective brain heart infusion broth for 48 hours and for all pathogens the antibiogram was determined.

Materials and Methods

We conducted an observational, descriptive, and cross-sectional study in the Multifunctional Intensive Care Unit of Saint Louis Regional Hospital in Senegal. The study concerned the care setting, the medical devices, and the contact surfaces of the care staff. The care facilities in the intensive care unit consist of 7 warm beds in the common room and 2 beds in the isolation room. The department has 3 anesthetists, 14 nurses, and two cleaners. Samples were taken using sterile swabs from medical devices, surfaces, and staff attending the ward during the study period. The technique consisted of moistening a swab with saline solution, then passing it over the surface to be sampled by making parallel and close streaks while slightly rotating the wet swab. A sampling of the same area was repeated by making striations perpendicular to the first. The different swabs were quickly transported in their sterile protective case to the laboratory for bacteriological examination and antibiotic susceptibility testing (using an antibiotic disc) after swabbing. The samples were cultured on a non-selective brain heart infusion broth for 48 hours. We collected data on the nature of the sites sampled, the germs found, and the antibiogram of the pathogens.

Results

Overall 21 samples were taken. Samples were taken from staff hands in 66.6% of cases (n=14), from resuscitation beds in 19% of cases (n=4), and from resuscitation ventilators in 14% of cases (n=3). Gram staining identified gram-positive bacilli in 76% of cases (n=16), gram-positive cocci in clusters in 23.8% (n=5), and gram-positive cocci in diplococci in 19% (n=4). A second isolation medium EMB, GSO, and Chapman were required for bacteriological identification. A total of 8 pathogens were identified, giving a positivity rate of 38%. Klebsiella pneumonia was identified at 5 sites, accounting for 23.8% of cases, staphylococcus aureus at 2 sites, representing 9.5% of cases, and pseudomonas aeruginosa was identified at 1 site, corresponding to 4.7% of cases. Table 1 shows the pathogens and the colonized sites. Antibiotic resistance testing (antibiotic susceptibility testing) found extended-spectrum beta-lactamase (ESBL) secreting strains of klebsiella pneumonia in 100% of cases. Staphylococcus aureus strains were sensitive to meticillin (Meti-S) in 100% of cases and the pseudomonas strain found was sensitive to imipenems. The resistance analysis in our study showed an antibiotic resistance rate of 62.5% (n=5). Table 2 shows the distribution of pathogens according to antibiotic resistance or sensitivity.

Table 1: distribution of pathogens according to sampling sites.

Sampling sites	Pathogens	Percentage	Total
Ventilator 1	Klebsiella pneumonia	23,8% (n=5)	38% (n=8)
Ventilator 2	Klebsiella pneumonia		
Bed 2	Klebsiella pneumonia		
Bed 3	Klebsiella pneumonia		
Personnel 7	Klebsiella pneumonia		
Personnel 5	Staphylococcus aureus	4,7% (n=1)	
Personnel 9	Staphylococcus aureus		
Bed 1	Pseudomonas aeruginosa	4,7% (n=1)	

Table 2: distribution of pathogens according to resistance and/or sensitivity.

	Pathogens	Resistance/Sensitivity	Percentage
Resistants Germs n=5	Klebsiella pneumonia	ESBL	62,5%
	Klebsiella pneumonia	ESBL	
	Klebsiella pneumonia	ESBL	
	Klebsiella pneumonia	ESBL	
	Klebsielle pneumonia	ESBL	
Sensitive Germs n=3	Staphylococcus aureus	Sensitive to Meticillin	37,5%
	Staphylococcus aureus	Sensitive to Meticillin	
	Pseudomonas aeruginosa	Sensitive to Imipenems	

Discussion

A nosocomial infection is an infection that is not present or incubating at the time of admission. By convention, an infection occurring more than 48 hours after admission, or directly related to a health care procedure (regardless of when it occurred), is considered nosocomial [1]. The routes of contamination of a patient in the ICU are either endogenous or exogenous. The endogenous route is the main source of hospital infections. This means that normally sterile sites are contaminated and then colonized by the flora carried by the patient himself, as a result of a breakdown in defense barriers. The exogenous route is associated with the colonization, possibly followed by infection, of the patient by external bacteria, coming from other patients or a free environment (for example legionellosis), transmitted indirectly (aerosols, handling, materials). This route is relatively more important in the ICU than in other sectors, due to the density of care and the frequency of procedures, increasing the risk of exposure of patients to the transmission of bacteria from one patient to another (cross-transmission) [2]. This observation on the routes of contamination of nosocomial infection justifies the relevance of our study in identifying the germs involved in nosocomial infection by the exogenous route. Microbiological sampling of the environment of hospital wards makes it possible to determine the microbial reservoir at the origin of hospital-acquired infections [3,4]. These microbial reservoirs are one of the key indicators of poor hospital hygiene [5].

Elisabetta Kuczewski et al. [6] in their study on bacterial cross-transmission between inanimate surfaces and patients in intensive care units found that the trends of positive samples were 89.7% in ICU 1 and 88.4% in ICU 2. Overall, 90.7% of near-patient samples were positive and 87.9% of distant samples were positive; 55.7% of positive samples were polymicrobial, and 44.3% were monomicrobial [6]. In their study, the most contaminated sites were: bedrails, computer keyboard and mouse, and the bedside table. The germs found were enterococcus faecium (13%), acetobacter baumannii (11.4%), staphylococcus aureus (6%), and pseudomonas aeruginosa (n = 5, 2%) [6]. In the study by Ango PD et al on the microbial ecology of surfaces and medical devices in the intensive care unit of the Treichville University Hospital, the sink and cupboards were the most soiled surfaces, followed

How to cite this article: Diedhiou M, Lo S, Dieye A, Sarr N, Dia AD, Dia NM and Fall ML. Determination of the Bacterial Ecology of the Intensive Care Unit of Saint Louis Regional Hospital, Senegal. J Anest & Inten care med. 2023; 12(4): 555842. DOI: 10.19080/JAICM.2023.12.555842

by injectors and blood pressure cuffs [7]. In the study by Latifa Merzougui et al, all extrinsic factors studied were statistically significantly related to nosocomial infection [8]. Our study mainly found pathogens on staff hands, beds, and ventilators. This is related to insufficient hand washing between and aftercare and a lack of bio-cleaning of beds and medical devices. These data from the literature show the importance of determining the pathogens in the care environment, which remains an indicator of the quality of hygiene in the care facility. Many pathogens require a living host to survive, while others may be able to persist in a dormant state outside a living host. Nevertheless, all pathogens need mechanisms to move from one host to another. Most nosocomial pathogens can persist on inanimate surfaces for weeks or even months [9].

In hospitals, hand contact surfaces are often contaminated with nosocomial pathogens [10,11], and can serve as vectors for cross-transmission. Single-hand contact with contaminated surfaces results in a variable degree of pathogen transfer. Scot E et al, noted that hand transmission of infection was most common with Escherichia coli, Salmonella spp, and Staphylococcus aureus in 100% of cases [12]. In addition to bacteria, contaminated hands can transmit viruses to 5 other surfaces [13] or to other subjects [14]. Contaminated hands can also cause recontamination of the surface [15,16]. Studies reported by Laborde DJ and Farrington M show that the main transmission route is through caregivers' transiently contaminated hands [17,18]. Similarly, Elahe Tajeddin et al concluded their work on the role of the ICU environment and nursing staff in the transmission of bacteria associated with nosocomial infections, stating that their results identify ICU staff and environmental surfaces as likely sources of bacterial agents involved in nosocomial infections in the ICUs studied in Tehran. They further report that although Staphylococcus aureus and Staphylococcus epidermidis were determined to be the dominant bacteria in both types of samples, Acetobacter baumannii had the highest frequency on environmental surfaces. [19]. This was also the case in our study, which found contamination of staff hands in 66% of cases. However, the risk from contaminated surfaces cannot be overlooked due to the overwhelming evidence of poor hand hygiene compliance. An important characteristic of the germs that colonize intensive care units is that they are more or less resistant to antibiotics, or even multi-resistant (MRB). This is related to the high frequency of antibiotic prescriptions in intensive care units. In addition, there is an increased circulation of antibiotic-resistant strains in the general population, due to, among other things, the frequency of antibiotic treatment which selects resistant strains such as methicillin-resistant Staphylococcus aureus (MRSA), and the frequent readmission of patients [1].

The population of resistant germs in the ICU environment was also studied by Elahe Tajeddin et al who reported that: imipenem-resistant phenotypes were found in 67% of environmental isolates, with acinetobacter Baumannii showing the highest resistance rates (94/100, 94%). In their study, ventilators were considered the main reservoir of imipenem-resistant bacteria among environmental samples. While Streptococcus and Staphylococcus saprophyticus isolates were among the most susceptible to the antibiotics studied, gentamicin resistance was observed in all these isolates (100%). Multidrug-resistant phenotypes were detected in 79.38% of the environmental samples and 35.89% of the samples collected from the hands of healthcare workers. In the case of samples from intensive care settings, the multidrug-resistant phenotype was most frequent for acinetobacter Baumannii (94%), followed by methicillin-resistant Staphylococcus aureus (MRSA) in 66.6% of cases, Klebsielle pneumoniae (54.5%), enterococcus spp (4/8 50%) and pseudomonas aeruginosa in 12.5% of cases [19].

The resistance analysis in our study showed an antibiotic resistance rate of 62.5%, mainly due to Klebsiella pneumonia. In our study the staphylococci isolated were methicillin-sensitive. Our resistance rate is lower than the study by Ango PD et al [7] who reported a 72% resistance profile for staphylococcus while other authors reported 100% resistance for staphylococcus (staphylococcus Meti-R) [20]. This is probably related to the fact that our sample was not very comprehensive and did not cover all surfaces and medical devices. ESBL-producing strains of Enterobacteriaceae were found in 66% of the cases in our study. This rate was significantly lower than in other hospitals [18]. ESBL-producing bacteria, due to their genetic determinism, are often resistant to several other antibiotics [21,22]. This observation reflects the presence of multi-drug-resistant bacteria and beta-lactamase-producing strains on surfaces and medical devices in the department. This can be explained by the fact that antibiotics are over-prescribed in our department and beta-lactamin antibiotics are at the top of the list [23]. The pseudomonas found in our series were sensitive to imipenems, which remains the last therapeutic alternative in our context. The presence of these bacteria was related to our difficult working conditions. The frequent and often inappropriate use of antibiotics in hospitals could be the origin of this situation. In addition, decontamination measures seem to be ineffective in healthcare facilities, and this would contribute to the emergence of these multi-resistant bacteria in the environment.

Finally, any critical care practitioner should be aware that pathogens have the ability to survive in inert environments. The main factors associated with the ability of a nosocomial pathogen to survive on inanimate surfaces and equipment are the specific characteristics of the microorganism (such as genus, species, specific strain, ability to form a biofilm, and concentration of the microorganism) and environmental factors (such as UV radiation, temperature, humidity, presence of organic material, and type of surface) [24,25]. Evidence of the ability to survive in environmental reservoirs has been reported for bacteria (C. difficile, VRE, MRSA, P. aeruginosa, Escherichia coli, Klebsiella spp. and Acinetobacter spp.), viruses (influenza, parainfluenza, enteric, hepatitis B) and fungi (Candida albicans, Candida glabrata, Candida parapsilosis, Aspergillus spp. and Zygomycetes) [26]. Bacteria are able to form biofilms also on dry inanimate surfaces. It has been assumed that biofilm formation may be favoured by a thin film of water resulting from condensation on surfaces or that the relative humidity in

How to cite this article: Diedhiou M, Lo S, Dieye A, Sarr N, Dia AD, Dia NM and Fall ML. Determination of the Bacterial Ecology of the Intensive Care Unit of Saint Louis Regional Hospital, Senegal. J Anest & Inten care med. 2023; 12(4): 555842. DOI: 10.19080/JAICM.2023.12.555842

intensive care units is high enough to allow biofilm formation [27]. Biofilms contain a high bacterial load capable of surviving for a long time on dry hospital surfaces and also have an increased resistance to inactivation by disinfectants. Indeed, biofilm bacteria are up to 1000 times more resistant to disinfectants than their corresponding planktonic form [27,28]. Pseudomonas aeruginosa in its biofilm is able to survive a 5-minute treatment with peracetic acid at a concentration of 2000 parts per million, which is the working concentration used by some washer-disinfectors [29].

Conclusion

Our study illustrates the difficulties we have in identifying, cleaning, and disinfecting the infectious ecological niches in the current practice of our department. These pathogenic bacteria in the department's ecosystem are the cause of nosocomial infections, which makes it essential to control the hospital setting. This is achieved through regular cleaning of the premises (floor and surfaces), compliance with hygiene rules by the staff, and good antibiotic therapy practices.

References

1. Buisson BC, Travail et le (2005) Risques et maîtrise des infections nosocomiales en réanimation : texte d'orientation SRLF/SFAR. Réanimation 14(6): 463-471.
2. (2002) Recommandations des experts de la SRLF : prévention de la transmission croisée en réanimation. Réanimation 11: 250-256.
3. Talon D (1999) The role of the hospital environment in the epidemiology of multi-resistant bacteria. J Hosp Infect 43(1): 13-17.
4. Meunier O, Hernandez C, Piroird M, Heilig R, Steinbach D, et al. (2005) Prélèvements bactériologiques des surfaces importance de l'étape d'enrichissement et du choix des milieux de culture. Ann Biol Clin 63(5): 481-486.
5. (2003) Infection Control Practices Advisory Comitee. Recommendations of CDC and Healthcare. Guidelines for environmental infection control in health care facilities. MMWR 52: RR10.
6. Kuczewski E, Henaff L, Regard A, Laurent A, Pierre C (2022) Bacterial Cross-Transmission Between Inanimate Surfaces And Patients In Intensive Care Units Under Real-World Conditions: A Repeated Cross-Sectional Study. International Journal of Environmental Research and Public Health 19(15): 9401.
7. Ango PD, Konan KD, Kouame KA, Sai SS, Tchimou AY, et al. (2020) Écologie Microbienne des Surfaces et Dispositifs Médicaux au Service de Réanimation du Centre Hospitalier et Universitaire (CHU) de Treichville. Health Sciences and Disease 21(1).
8. Merzougui L, Barhoumi T, Guizani T, Hafed B, Elyess T, et al. (2018) Les infections nosocomiales en milieu de réanimation : incidence annuelle et aspects cliniques au Service de Réanimation Polyvalente, Kairouan, Tunisie, 2014. Pan African Medical Journal 30 : 143.
9. Kramer A, Schwebke I, Kampf G (2006) How long do nosocomial pathogens persist on inanimate surfaces? A systematique review. BMC infectious diseases 6: 130.
10. Bures S, Fishbain JT, Uyehara CF, Parker JM, Berg BW (2000) Computer keyboards and faucet handles as reservoirs of nosocomial pathogens in the intensive care unit. American Journal of Infection Control 28(6): 465-471.
11. Boyce JM, Bynoe GP, Chenevert C, King T (1997) Environmental contamination due to methicillin-resistant Staphylococcus aureus: possible infection control implications. Infection Control and Hospital Epidemiology 18(9): 622-627.
12. Scott E, Bloomfield SF (1990) The survival and transfer of microbial contamination via cloths, hands and utensils. Journal of Applied Bacteriology 68(3): 271-278.
13. Barker J, Vipond IB, Bloomfield SF (2004) Effects of cleaning and disinfection in reducing the spread of norovirus contamination via environmental surfaces. Journal of Hospital Infection 58(1): 42-44.
14. Von Rheinbaben F, Schunemann S, Gross T, Wolff MH (2000) Transmission of viruses via contact in a household setting: experiments using bacteriophage strain phiXI174 as a model virus. Journal of Hospital Infection 46: 61-66.
15. Mbithi JN, Springthorpe VS, Boulet JR, Sattar SA (1992) Survival of hepatitis A virus on human hands and its transfer on contact with animate an inanimate surfaces. Journal of Clinical Microbiology 30(4): 757-763.
16. Barker J, Vipond IB, Bloomfield SF (2004) Effects of cleaning and disinfection in reducing the spread of norovirus contamination via environmental surfaces. Journal of Hospital Infection 58(1): 42-44.
17. Laborde DJ, Weigle KA, Weber DJ, Kotch JB (1993) Effect of fecal contamination on diarrheal illness rates in day-care centers. American Journal of Epidemiology 138(4): 243-255.
18. Farrington M, Ling J, Ling T, French GL (1990) Outbreaks of infection with methicillin-resistant Staphylococcus aureus on neonatal and burns units of a new hospital. Epidemiology and Infection 105(2): 215-228.
19. Tajeddin E, Rashidan M, Razaghi M, Sima SSJ, Nahid M, et al. (2016)The role of the intensive care unit environment and health-care workers in the transmission of bacteria associated with hospital acquired infections. Journal of infection and public health 9(1): 13-23.
20. Guessennd NK, Ouattara MB, Ouattara ND, Nevry RK, Gbonon V, et al. (2013) Étude des bactéries multirésistantes des effluents hospitaliers d'un centre hospitalier et universitaire (CHU) de la ville d'Abidjan (Côte d'ivoire). J Appl Biosci 69: 54-64.
21. Philippon A, Arlet G, Lagrange PH (1994) Origin and impact of plasmid-mediated extended-spectrum beta-lactamases. Eur J Clin Microbiol Infect Dis 13 Suppl 1:S17-29.
22. Tahou JE, Guessennd NK, Sokouri PD, Gbonon V, Konan F, et al. (2017) Antimicrobial Resistance of Klebsiella pneumoniae-ESBL Producing Strains Isolated from Clinical Specimens in Abidjan (Côte de Ivoire). Microbiol Research I J 20(2): 1-7.
23. Dosso M, Bissagnené E, Coulibaly M, Kette PH, Diaha H, et al. (2000) Résistances acquises et prescriptions d'antibiotiques en Afrique : quelles adéquations?. Med Mal Infect 30(Suppl 3): 197-204.
24. Esteves DC, Pereira VC, Souza JM, Rogéria K, Rebeca DS, et al. (2016) Influence of biological fluids in bacterial viability on different hospital surfaces and fomites. American Journal of Infection Control 44(3): 311-314.
25. Abreu AC, Tavares RR, Borges A, Mergulhão F, Simões M (2013) Current and emergent strategies for disinfection of hospital environments. Journal of Antimicrobial Chemotherapy 68(12) : 2718-2732.
26. Russotto V, Cortegiani A, Fasciana T, Lozzo P, Santi MR, et al. (2017) What healthcare workers should know about environmental bacterial contamination in the intensive care unit. BioMed Research International 2017: 6905450.

How to cite this article: Diedhiou M, Lo S, Dieye A, Sarr N, Dia AD, Dia NM and Fall ML. Determination of the Bacterial Ecology of the Intensive Care Unit of Saint Louis Regional Hospital, Senegal. J Anest & Inten care med. 2023; 12(4): 555842. DOI: 10.19080/JAICM.2023.12.555842

27. Vickery K, Deva A, Jacombs A, Allan J, Valente P, et al. (2012) Presence of biofilm containing viable multiresistant organisms despite terminal cleaning on clinical surfaces in an intensive care unit. Journal of Hospital Infection 80(1) : 52-55.

28. Gunther F, Blessing B, Tacconelli E, Mutters NT (2017) MRSA decolonization failure-are biofilms the missing link?. Antimicrobial Resistance and Infection Control 6(1): 32.

29. Akinbobola A, Sherry L, Mckay W, Ramage G, Williams C (2017) Tolerance of Pseudomonas aeruginosa in in-vitro biofilms to high-level peracetic acid disinfection. Journal of Hospital Infection 97(2): 162-168.

DOI: 10.19080/JAICM.2023.12.555842

How to cite this article: Diedhiou M, Lo S, Dieye A, Sarr N, Dia AD, Dia NM and Fall ML. Determination of the Bacterial Ecology of the Intensive Care Unit of Saint Louis Regional Hospital, Senegal. J Anest & Inten care med. 2023; 12(4): 555842. DOI: 10.19080/JAICM.2023.12.555842