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DEMAND FOR MICROBIOLOGICAL CULTURES AND PREVALENCE OF MICROORGANISMS IN A UNIVERSITY HOSPITAL FROM THE PERNAMBUCO STATE*

Demanda de culturas microbiológicas e prevalência de microrganismos em um hospital universitário de Pernambuco

Demanda de culturas microbiológicas y prevalencia de microrganismos en un hospital universitario de Pernambuco

*Article based on the monograph Prevalence of microorganisms isolated from cultures of the University Hospital of the São Francisco Valley Federal University, defended in 2016 at the São Francisco Valley Federal University (UNIVASF).

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ABSTRACT

Objective: the study's purpose has been to verify the demand for blood cultures, tracheal aspirates and urine cultures performed at a University Hospital from the *Universidade Federal do Vale do São Francisco (HU-UNIVASF/EBSERH),* as well as the predominance of microorganisms identified over the period from January to June 2016. **Methods:** it is a retrospective documentary study with a quantitative approach. **Results:** the microbiology sector carried out 488 blood cultures, 427 urine cultures and 197 tracheal aspirates. The positivity of blood cultures was between 10.9 and 25.7%, and the percentage of contaminations ranged from 6.8 to 14.0%. The most prevalent microorganisms in blood cultures were *Staphylococcus epidermidis* (23.7%), *Staphylococcus aureus* (19.3%) and *Klebsiella pneumoniae* (9.6%). In urine cultures were *Klebsiella pneumoniae* (23.1%), *Candida sp.* (13.5%) and *Escherichia coli* (12.5%). In tracheal aspirates were *Acinetobacter baumannii* (29.2%), *Pseudomonas aeruginosa* (26.6%) and *Staphylococcus aureus* (16.2%). **Conclusion:** the most requested culture was blood culture. The most prevalent bacterium in blood cultures was *Staphylococcus epidermidis*, in tracheal aspirates was *Acinetobacter baumannii,* and in urine cultures was *Klebsiella pneumoniae*.

Descriptors: Blood culture; Microorganisms; Hospital infection; Prevalence.

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RESUMO

Objetivo: verificar a demanda de hemoculturas, aspirados traqueais e uroculturas realizadas no HU-UNIVASF/EBSERH e a prevalência dos microrganismos identificados no período de janeiro a junho de 2016. **Métodos**: estudo retrospectivo documental com abordagem quantitativa. **Resultados:** o setor de microbiologia realizou 488 hemoculturas, 427 uroculturas e 197 aspirados traqueais. A positividade de hemoculturas mostrou-se entre 10,9 à 25,7%, e o percentual de contaminações variou de 6,8 à 14,0%. Os microrganismos mais prevalência nas hemoculturas foram *Staphylococcus epidermidis* (23,7%), *Staphylococcus aureus* (19,3%) e *Klebisiella pneumoniae* (9,6%). Nas uroculturas foram *Klebisiella pneumoniae* (23,1%), *Candida sp.* (13,5%) *e Escherichia coli* (12,5%). Nos aspirados traqueais foram *Acinetobacter baumannii* (29,2%), *Pseudomonas aeruginosa* (26,6%) e *Staphylococcus aureus* (16,2%). **Conclusão**: a cultura mais solicitada foi hemocultura. A bactéria mais prevalente nas hemoculturas foi *Staphylococcus epidermidis,* nos aspirados traqueais *Acinetobacter baumannii* e nas uroculturas *Klebisiella pneumoniae.*

Descritores: Hemocultura; Microrganismos; Infecção hospitalar; Prevalência.

RESUMEN

Objetivo: el propósito del trabajo es verificar la demanda de hemocultivos, aspirados traqueales y urocultivos realizados en el Hospital Universitário de la Universidade Federal do Vale do São Francisco (HU-UNIVASF/EBSERH) y la prevalencia de los microorganismos identificados en el período de enero a junio de 2016. **Métodos:** este trabajo es un estudio retrospectivo documental con abordaje cuantitativo. **Resultados:** el sector de microbiología realizó 488 hemocultivos, 427 urocultivos y 197 aspirados traqueales. La positividad de hemocultivos se mostró entre el 10,9 al 25,7%, y el porcentaje de contaminaciones varía de 6,8 a 14,0%. Los microorganismos más prevalentes en los hemocultivos fueron Staphylococcus epidermidis (23,7%), Staphylococcus aureus (19,3%) y Klebsiella pneumoniae (9,6%). En los urocultivos fueron Klebisiella pneumoniae (23,1%), Candida sp. (13,5%) y Escherichia coli (12,5%). En los aspirados traqueales fueron Acinetobacter baumannii (29,2%), Pseudomonas aeruginosa (26,6%) y Staphylococcus aureus (16,2%). **Conclusión:** la cultura más solicitada fue hemocultivo. La bacteria más prevalente en los hemocultivos fue Staphylococcus epidermidis, en los aspirados traqueales, Acinetobacter baumannii y en los urocultivos, Klebisiella pneumoniae.

Descriptores: Hemocultivo; Microrganismos; Infección hospitalaria; prevalencia.

INTRODUCTION

Healthcare-Associated Infections (HAIs) are present in all units that provide health care services, so they develop in a patient who is assisted in any environment where health care is provided and is related to the reception of such care. It refers to any infection that develops during or as a result of admission to an acute care center and has not been incubated at the time of admission.[1]

HAIs is considered any clinical manifestation of infection that appears from 72 (seventy-two) hours after admission when the incubation period of the microorganism is unknown and there is no clinical evidence and/or laboratory data of infection at the time of hospitalization. It is still considered as HAIs that manifested before 72 (seventy-two) hours of hospitalization when associated with diagnostic and/or therapeutic procedures performed during this period.[2]

HAIs constitute a major threat to patient safety. Modern health care employs many types of invasive devices such as catheters or ventilators, as well as procedures to treat patients seeking to help them recover. Infections include: Central Line-Associated Blood Stream Infection (CLABSI), Catheter-Associated Urinary Tract Infections (CAUTI), Ventilator-Associated Pneumonia (VAP), and Surgical Site Infection (SSI).[3]

In CLABSI, the risk of infection increases after the third day of hospitalization and the highest rates in adults are observed with the femoral, jugular and subclavian vein insertion sites, respectively. The pathogenesis of the infection involves the skin flora colonizing the device. Infections within the first week after the placement are typically due to improper catheter insertion technique. Infections that occur after one week after catheter insertion are characteristically caused by intraluminal spread after contamination during handling. Among the pathogens involved 50% are *Coagulase-Negative Staphylococcus (CoNS)* and *Staphylococcus aureus*, Gram-negative bacilli 30%, *Enterococcus* 10%, and *Candida* species 10%. *S. aureus* has a significantly higher attributable mortality rate than other pathogens.[4]

CAUTI refers to an infection that occurs in a person whose urinary tract is currently catheterized within 48 hours. CAUTI in the Intensive Care Unit (ICU) may be caused by *Staphylococcus* and *Pseudomonas*, as well as acquired pathogens (Gram-negative, Enterococcus). *Candida* is a species that commonly represents colonization in patients who have received broad-spectrum antibiotics, even in immunocompromised patients.[4]

Concerning microbiology, a broad spectrum of organisms causes VAP, including aerobic Gram-negatives (*Acinetobacter baumannii*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumoniae* and *Enterobacter*); Gram-positive cocci (Streptococcus and Enterococcus) and oropharyngeal flora. Some of them may be multidrug-resistant, however, local epidemiology is rather important.[4]

Bacteremia is one of the most frequent and serious complications affecting mainly immunosuppressed patients, besides prolonging the hospitalization period, it is related to high morbidity and mortality rates of hospitalized patients.[5]

HAIs results in longer hospitalization, increased costs to the health system, the appearance of other associated diseases, and increase the resistance of microorganisms to the antimicrobial agents used, becoming a major problem for patient safety.[6]

Rapid and accurate diagnosis of HAIs improves patient outcomes and decreases the evolution of selection for

antimicrobial resistance. It gives patients more effective treatment by allowing the rapid withdrawal of unnecessary antibiotics. Correct timing is vital with all microbiological tests and a good quality sample should be collected before starting or changing antibiotics.[4]

The transmission of infectious diseases in a hospital is a concern of all healthcare professionals within an institution, especially the *Setor de Comissão de Controle de Infecções Relacionadas à Assistência à Saúde (SCIRAS)* [Healthcare-Related Infection Control Commission Sector]. HAIs can be acquired by any individual who is hospitalized, because in this environment they are vulnerable to being exposed to a wide variety of pathogenic microorganisms, in addition to being subject to different invasive procedures.

Studies report that nosocomial infections account for 7% in developed countries and 10% in developing countries. Although Brazil has inconsistent data, the World Health Organization (WHO) estimates that around 15% of all hospitalized patients contract some HAIs, besides contributing to the increase in morbidity and mortality rates, they generate high hospitalization costs due to the patient's length of stay in the hospital, in addition to causing changes in microbial resistance patterns.[7]

Given the importance of HAIs for health institutions, studies that evaluate the number of microbiological tests and prevalence of pathogens involved, become relevant to establish their prevention and control measures.

Bearing in mind the aforementioned, the objective of this study was to verify the demand for blood cultures, tracheal aspirates and urine cultures performed at a University Hospital named, *Hospital Universitário Dr Washington Antonio de Barros* from the *Universidade Federal do Vale do São Francisco (HU-UNIVASF/EBSERH).* Furthermore, to verify the prevalence of microorganisms identified over the period from January to June 2016.

METHODS

This is a longitudinal retrospective documentary study with a quantitative approach. This study was performed at the *Setor de Comissão de Controle de Infecções Relacionadas à Assistência à Saúde (SCIRAS)* [Healthcare-Related Infection Control Commission Sector] from the *HU-UNIVASF/EBSERH*, which is located in *Petrolina* City, *Pernambuco* State. The hospital is the reference unit for the Interstate Health Care Network of the *Médio do Vale do São Francisco - Pernambuco-Bahia*, composed of six health micro-regions covering 53 cities.

Data collection was performed by collecting information from electronic spreadsheets provided by the hospital laboratory, from hospitalized patients, which group data from cultures collected in Adult Intensive Care Unit (ICU-A), Red Room, Yellow Room, Green Room, Blue Room, Surgical, Medical, and Orthopedic Clinic, from January to June 2016.

Inclusion criteria were as follows: blood cultures, urine cultures and cultures of tracheal aspirates performed at the *HU-UNIVASF/EBSERH*, from January to June 2016.

Exclusion criteria were as follows: other cultures performed at the *HU-UNIVASF/EBSERH* such as cavity fluids and secretions in general.

Data were entered into spreadsheets and graph files in Excel and Word software from Microsoft Office version 7.0 for Windows and descriptive analysis was performed with absolute and percentage values.

The project was previously approved by the *Comitê de Ética e Deontologia em Estudos e Pesquisas (CEDEP)* [Ethics and Deontology Committee in Studies and Research] of the *Universidade Federal do Vale do São Francisco (UNIVASF)*, according to *Certificado de Apresentação para Apreciação Ética (CAAE)* [Certificate of Presentation for Ethical Appreciation] No. 61429916.7.0000.5196. This study was conducted according to the ethical aspects of the research advocated by the Resolution No. 466/12 of the National Health Council - Ministry of Health that guides the practices in research with human beings.[8]

RESULTS

During the study period, the microbiology sector performed 1,112 cultures, of which 488 blood cultures, 427 urine cultures and 197 tracheal aspirates from patients admitted to the *HU-UNIVASF/EBSERH*. The most requested cultures were blood cultures (43.9%), followed by urine cultures (38.4%) and tracheal aspirates (17.7%) (**Table 1**). Microbiological cultures are of vital importance in a hospital, as medical staff need not only detailed clinical evaluation but also laboratory support which will be the primary means of clinical diagnosis.

It is observed that the demand for exam requests is equally distributed throughout the study period, in other words, there is a trend in which the most requested exam was blood culture, followed by urine culture and tracheal aspirate. In this sense, the ICU-A was the largest applicant with a percentage of (45%) requests, followed by the Medical Clinic with (24.9%), Yellow Room with (7.6%) and Red Room representing (7.5%), (**Table 1**).

Analyzing blood cultures for positivity, it can be seen as shown in **Figure 1** that, in January, February, and March, the lowest percentages were distributed, respectively, of 10.9%, 13.6%, and 12%. On the other hand, the months of April, May, and June expressed the highest percentages of positive samples, being 20.3%, 18.8%, and 25.7% respectively. The average of positive samples of the semester was approximately 17% with the exception of contaminants.

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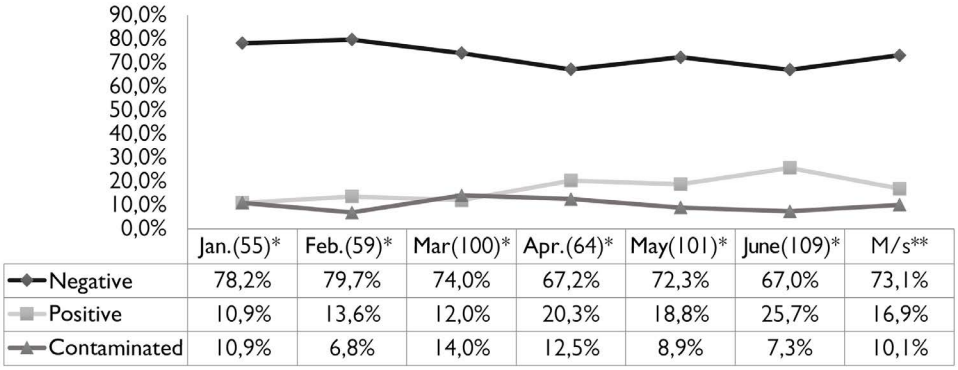
Table 1. Request for blood cultures, urine cultures and tracheal aspirates by sectors of the *HU-UNIVASF/EBSERH*, considering the period from January to June, *Petrolina* City, *Pernambuco* State, Brazil, 2016.

Sectors	Cultures		Blood cultures		Urine cultures		Tracheal aspirates	
			(N)	(%)	(N)	(%)	(N)	(%)
Adult Intensive Care Unit	(N)	500						
	(%)	45.0						
Medical Clinic	(N)	277						
	(%)	24.9						
Surgical Clinic	(N)	65						
	(%)	5.8						
Orthopedic Clinic	(N)	19						
	(%)	1.7						
Red Room	(N)	83	488	43.9	427	38.4	197	17.7
	(%)	7.5						
Yellow Room	(N)	85						
	(%)	7.6						
Green Room	(N)	43						
	(%)	3.9						
Blue Room	(N)	23						
	(%)	2.1						
Unspecified	(N)	17						
	(%)	1.5						
Total	(N)	1,112			1,112			
	(%)	100			100			

(N) Absolute value of the number of cultures.



	Jan.(55)*	Feb.(59)*	Mar(100)*	Apr.(64)*	May(101)*	June(109)*	M/s**
Negative	78,2%	79,7%	74,0%	67,2%	72,3%	67,0%	73,1%
Positive	10,9%	13,6%	12,0%	20,3%	18,8%	25,7%	16,9%
Contaminated	10,9%	6,8%	14,0%	12,5%	8,9%	7,3%	10,1%

(*) Absolute monthly value of the number of blood cultures samples.

(**) Percentages of the half-yearly average of negative, positive and contaminated sample results.

Figure 1 - Monthly percentage of positive, negative and contaminated blood cultures collected at the *HU-UNIVASF/EBSERH* from January to June, *Petrolina* City, *Pernambuco* State, Brazil, 2016.

Concerning the percentage of contamination, it can be observed that there was variation over the months, with values from 6.8% to 14%, representing a semiannual average of approximately 10% (**Figure 1**).

Regarding the prevalence of microorganisms in blood cultures, it can be observed in **Table 2** that the most prominent sector was the ICU-A with (55/40.7%) of the identified isolates, followed by the Medical Clinic (28/20, 7%) and Yellow Room (18/13.3%).

The data demonstrated in **Table 2** show that of the 135 positive blood cultures there was a predominance of *Staphylococcus epidermidis* (23.7%) followed by *S. aureus* (19.3%), *K. pneumoniae* (9.6%), *Staphylococcus haemolyticus* (7.4%), and *CoNS* (5.9%). The finds for *Staphylococcus hominis* and *A. baumannii* were similar to E. coli (5.2%).

For urine culture, **Table 3** shows the presence of a larger number of microorganisms in the Medical Clinic (34/32.7%), followed by ICU-A (29/27.9%) and Yellow Room (13/12.5%). The most prevalent bacteria were *K. pneumoniae* (23.1%), *Candida sp.* (13.5%), *E. coli* (12.5%), and *Enterococcus faecalis* (7.7%).

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Table 2 - Prevalence of microorganisms in blood cultures, requested by sectors, regarding the patients hospitalized at the *HU-UNIVASF/EBSERH* from January to June, *Petrolina* City, *Pernambuco* State, Brazil, 2016.

Blood Cultures										
Microorganisms	**ICU-A**	**Medical Clinic**	**Surgical Clinic**	**Orthopedic Clinic**	**Red Room**	**Yellow Room**	**Green Room**	**Blue Room**	**Unspecified**	**(%)**
Staphylococcus epidermidis	15	8	1	*	5	3	*	*	*	23.7
Staphylococcus aureus	7	5	5	*	4	4	*	1	*	19.3
Klebsiella pneumoniae	7	3	1	*	*	2	*	*	*	9.6
Staphylococcus haemolyticus	7	1	*	*	1	1	*	*	*	7.4
Coagulase-negative staphylococcus	*	4	*	*	1	2	1	*	*	5.9
Escherichia coli	1	*	1	1	1	*	1	1	1	5.2
Staphylococcus hominis	5	1	*	*	1	*	*	*	*	5.2
Acinetobacter baumannii	3	*	*	1	*	3	*	*	*	5.2
Enterococcus faecalis	2	*	*	*	2	2	*	*	*	4.4
Serratia marcescens	1	*	*	*	*	*	*	1	*	1.5
Group B Streptococcus agalactiae	1	1	*	*	*	*	*	*	*	1.5
Candida sp.	1	1	*	*	*	*	*	*	*	1.5
Proteus mirabilis	2	*	*	*	*		*	*	*	1.5
Corynebacterium spp.	2	*	*	*	*	*	*	*	*	1.5
Enterobacter cloacae	1	*	*	*	*	*	*	*	*	0.7
Salmonella spp.	*	*	*	*	1	*	*	*	*	0.7
Staphylococcus saprophyticus	*	*	*	*	*	*	1	*	*	0.7
Pseudomonas aeruginosa	*	*	*	*	*	1	*	*	*	0.7
Enterobacter faecalis	*	1	*	*	*	*	*	*	*	0.7
Enterococcus sp.	*	1	*	*	*	*	*	*	*	0.7
Yeast	*	1	*	*	*	*	*	*	*	0.7
Streptococcus spp.	*	1	*	*	*	*	*	*	*	0.7
Pseudomonas spp.	*	*	1	*	*	*	*	*	*	0.7
										100
Total (N=135)	55	28	9	2	16	18	3	3	1	
Total (%)	40.7	20.7	6.7	1.5	11.9	13.3	2.2	2.2	0.7	100

(*) Not found.

(N) Absolute value of microorganism number.

Table 3 - Prevalence of microorganisms in urine cultures, requested by sector, regarding the patients hospitalized at the *HU-UNIVASF/EBSERH* from January to June, *Petrolina* City, *Pernambuco* State, Brazil, 2016.

Urine cultures										
Microorganisms	**ICU-A**	**Medical Clinic**	**Surgical Clinic**	**Orthopedic Clinic**	**Red Room**	**Yellow Room**	**Green Room**	**Blue Room**	**Unspecified**	**(%)**
Klebsiella pneumoniae	2	10	3	*	1	4	3	*	1	23.1
Candida sp.	9	3	*	*	*	2	*	*	*	13.5
Escherichia coli	3	*	3	*	2	2	*	*	3	12.5
Enterococcus faecalis	2	4	*	*	1	*	*	*	1	7.7
Acinetobacter baumannii	3	1	*	1	*	1	*	*	*	5.8

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Urine cultures										
Microorganisms	**ICU-A**	**Medical Clinic**	**Surgical Clinic**	**Orthopedic Clinic**	**Red Room**	**Yellow Room**	**Green Room**	**Blue Room**	**Unspecified**	**(%)**
Pseudomonas aeruginosa	2	2	*	1	*	*	*	1	*	5.8
Polymicrobial	1	*	1	*	*	3	1	*	*	5.8
Proteus mirabilis	*	3	*	1	1	*	*	*	*	4.8
Enterobacter cloacae	4	*	*	*	*	*	*	*	1	4.8
Morganella morganii	*	4	*	*	*	*	*	*	*	3.8
Staphylococcus aureus	*	1	*	1	*	*	*	*	1	2.9
Enterococcus faecium	1	1	*	*	*	*	*	*	*	1.9
Coagulase-negative Staphylococcus	*	1	*	*	*	*	*	*	*	1
Enterobacter sp.	1		*	*	*	*	*	*	*	1
Proteus penneri	*	1	*	*	*	*	*	*	*	1
Group D Streptococcus	*	1	*	*	*	*	*	*	*	1
Yeast	1		*	*	*	*	*	*	*	1
Klebsiella spp.	*	1	*	*	*	*	*	*	*	1
Acinetobacter lwoffii	*		*	*	*	1	*	*	*	1
Staphylococcus epidermidis	*	1	*	*	*	*	*	*	*	1
										100
Total (N=104)	29	34	7	4	5	13	4	1	7	
Total (%)	27.9	32.7	6.7	3.8	4.8	12.5	3.8	1	6.7	100

(*) Not found.

(N) Absolute value of microorganism number.

With regard to tracheal aspirates, **Table 4** shows that the ICU-A sector was the most prominent in the prevalence of microorganisms (107/69.5%), followed by the Medical Clinic (26/16.9%), and Yellow Room (15/9.7%). The most prevalent microorganisms were *A. baumannii* (29.2%), *P. aeruginosa* (26.6%), *S. aureus* (16.2%) and *K. pneumoniae* (11%).

Table 4 - Prevalence of microorganisms in tracheal aspirates, requested by sector, regarding the patients hospitalized at the *HU-UNIVASF/EBSERH* from January to June, *Petrolina* City, *Pernambuco* State, Brazil, 2016.

Tracheal aspirates							
Microorganisms	**ICU-A**	**Medical Clinic**	**Surgical Clinic**	**Red Room**	**Yellow Room**	**Unspecified**	**(%)**
Acinetobacter baumannii	33	7	1	*	4	*	29.2
Pseudomonas aeruginosa	25	9	*	*	6	1	26.6
Staphylococcus aureus	23	2	*	*	*	*	16.2
Klebsiella pneumoniae	8	4	1	2	2	*	11
Escherichia coli	4	1	*	*	*	*	3.2
Stenotrophomonas maltophilia	2	1	*	*	2	*	3.3
Enterobacter cloacae	3	*	*	*	1	*	2.6
Proteus mirabilis	1	1	*	1	*	*	1.9
Serratia marcescens	3	*	*	*	*	*	1.9

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	Tracheal aspirates						
Microorganisms	**ICU-A**	**Medical Clinic**	**Surgical Clinic**	**Red Room**	**Yellow Room**	**Unspecified**	**(%)**
Providencia stuartii	2	*	*	*	*	*	1.3
Staphylococcus haemolyticus	1	*	*	*	*	*	0.7
Enterobacter aerogenes	1	*	*	*	*	*	0.7
Staphylococcus epidermidis	1	*	*	*	*	*	0.7
Morganella morganii	*	1	*	*	*	*	0.7
							100
Total (N=154)	107	26	2	3	15	1	
Total (%)	69.5	16.9	1.3	1.9	9.7	0.6	100

(*) Not found.

(N) Absolute value of microorganism number.

DISCUSSION

Patients admitted to the ICU are often affected by numerous types of HAIs because they are critically ill and require various invasive procedures. About 30% of patients admitted to these units are estimated to have at least one infectious episode.[9] This is due to the peculiarity of ICU patients, such as the increasing complexity of patients treated associated with the type and duration of many invasive procedures such as bladder and venous catheterization, orotracheal intubation for mechanical ventilation, or failures related to the use of antimicrobials.[10]

One type of HAIs is that of the bloodstream, where there is the presence of bacteria that will be detected in the laboratory by blood culture examination, which, due to its importance, is very requested in hospitals, especially in ICU, because its result reflects directly on the therapy to be adopted by health professionals, with the objective of offering better recovery to the patient and contributing to the reduction of hospital morbidity and mortality.[11]

The diagnostic and prognostic value of blood culture has been steadily increasing, making it one of the most important microbiological tests.[12]

Blood culture contamination is a frequent problem in any hospital service. In this study, blood culture contamination rates were above those recommended throughout the period, ranging from 6.8 to 14% and an average of approximately 10%, far exceeding the 3% recommended by the Brazilian Society of Pathology, emphasizing that blood culture collection is a critical procedure and should be done using aseptic techniques to avoid sample contamination.[12]

The results found in this study corroborate other studies that attribute this high value of the contamination rate mainly to the collection technique. Through an actuation protocol, intrinsic collection factors responsible for blood culture contamination were analyzed, as follows: handwashing frequency, use of sterile techniques, contact with the venipuncture zone, number of needles used, respect for drying time, cleaning during the procedure, antiseptic used to clean the vials and skin, compression before or after needle extraction, volume of blood extracted per vial and extraction from existing catheters, when not intended to investigate this site.[13]

Using this same protocol, 564 blood cultures were analyzed, where contamination was observed in 92 samples, then representing a percentage of 16.31% of all requested blood cultures. Besides, there was variation in the months studied, with the month of October showing the highest number of contamination (23.85%) and January the month with the lowest number of contamination (9.85%). This shows that the number of blood culture requests is entirely linked to the particular factors of each institution. This same study points out that the main factor that causes sample contamination is the workload of the emergency department in which many blood cultures are prescribed, which possibly favors the use of an insufficient sterile technique.[13]

Among the most common pathogens found in SSI are *CoNS*, among them *S. epidermidis* which, although naturally found in human skin and being the main contaminant of blood cultures, is also capable of promoting major infections, as it is an infectious agent often isolated in ICUs.[14]

Regarding the positivity of samples for blood culture collection, studies show that one vial detects 65 to 91% of cases, while two vials show 80 to 99%, and three vials 93% or more. However, more vials do not increase detection.[12]

The positivity in blood cultures is very variable when compared to other studies, which is due to the type and degree of complexity of the institution. After evaluating the bacterial incidence of 846 blood cultures of ICU patients, 12.29% of

samples were positive for the presence of microorganisms and 87.71% were negative.[14]

Following the same line, another study evaluated 5,059 blood culture reports from six hospitals of the *Paraná* State from 2012 to 2014, where 613 reports (12.12%) showed bacterial growth. While the average prevalence of positive blood cultures was 19.39% in all hospitals evaluated. Nevertheless, when considered individually, it was found that hospital units H4, H5 and H6 had positive blood cultures higher than 20.00%. The H6 unit stood out with the highest percentage, and 38.58% of the requested blood cultures presented microbial growth. The fact that one hospital has more positive samples may indicate that the medical team is more careful to request blood culture, while in others with less positivity, the clinical staff requested more blood cultures, even with the chance of being negative, and therefore these data are insufficient for conclusions.[15]

It is suggested that the high incidence of SSI, and consequently positive blood cultures, observed in this study, is due to the attendance at the *HU-UNIVASF/EBSERH*, since it is a regional teaching and reference in hospitalizations of various specialties. Other factors that could justify would be the technique used in the collection and the number of bottles used in the institution, where 4 bottles are collected, then totaling 40 mL per patient.

As for the presence of bacteria, similar results were found in an ICU of a University Hospital of the *Sergipe* State from January 2012 to December 2014 that evaluated the incidence of microorganisms in 846 blood cultures of patients, and S. epidermidis (32, 69%) was the most predominant, followed by *S. aureus* (23.07%) and *K. pneumoniae* (7.69%).[16]

Following the same line, for one year, 1,080 positive blood cultures performed on patients admitted to the University Hospital of *Santa Maria* city, *Rio Grande do Sul* State, were analyzed. The Medical Clinic stood out as the second sector that made the most requests for cultures and presented the highest isolation percentage (203/18.8%). The most isolated microorganism was *S. epidermidis* (259/24%), followed by *S. hominis* (74/6.8%).

The data described in this research, in general, corroborate those of other studies where 5,059 blood culture reports from six hospitals in *Paraná* State from 2012 to 2014 were assessed. From the examinations performed, 613 positive blood cultures were identified, equivalent to a percentage of (12.12%). From these, 27 bacterial species were isolated, being *S. aureus* the most prevalent (17.94%), followed by *S. epidermidis* (16.26%) and *K. pneumoniae* (14.52%).[15]

Similar to our study, there were found a wide variety of bacteria identified in blood cultures, but with great potential risk to patients, such as *Serratia marcescens*, *Proteus mirabilis*, and *Salmonella spp*. Moreover, bacteria with great epidemiological relevance of the genus *Staphylococcus* had a high prevalence such as *S. aureus* (17.94%), *S. epidermidis* (16.26%), *S. haemolyticus* (5.55%), *S. hominis* (4,72%), *S. capitis* (1.30%) and *S. saprophyticus* (0.16%).[15]

S. aureus is a bacterium commonly found on the skin and nose of about 30% of individuals. Anyone can develop a *Staphylococcus* infection, although certain groups of people are most at risk, including people with chronic diseases such as diabetes, cancer, vascular disease, eczema, and lung disease. In health care settings, these infections can be serious or fatal, including: bacteremia or sepsis when bacteria spread to the bloodstream; pneumonia, which predominantly affects people with underlying lung disease, including those on mechanical ventilators; endocarditis that can lead to heart failure or stroke and osteomyelitis. These bacteria may also become resistant to certain antibiotics including Methicillin-Resistant S. aureus (MRSA), Vancomycin-Intermediate S. aureus (VISA) and Vancomycin-Resistant S. aureus (VRSA).[17]

Klebsiella is a type of gram-negative bacterium that is normally found in the human intestine in a commensal manner, however, it can cause different types of healthcare-associated infections through person-to-person contact, including pneumonia, SSI, wound infections or surgical sites and meningitis. Patients whose care requires invasive devices such as mechanical ventilators or intravenous catheters and patients who are on prolonged antibiotic therapy are at greater risk of infections with this bacterium. Increasingly, *Klebsiella* bacteria are developing antimicrobial resistance.[17]

At the regional level, regarding the distribution of the most frequent microorganisms reported by the etiologic agents of *infecções primárias de corrente sanguínea confirmada laboratorialmente (IPCSL)* [Laboratory-Confirmed Primary Bloodstream Infection] in adult ICU patients, the Northeast points out of the *CoNS* corresponding to 18.3%, followed by *Acinetobacter spp.* (13.5%), *K. pneumoniae* 12.9% and *P. aeruginosa* with 12.4% of notifications. In our study, it showed similar data, since the most incident microorganisms were S. epidermidis appearing in the first position and *K. pneumoniae* in the third position.[18]

Analogously, it follows when compared at the national level. Among the *IPCSL*s associated with Central Venous Catheter (CVC) in hospitalized patients from adult ICUs, there were (15,434) notifications for 2014. Microorganisms reported as etiological agents have grouped in the national database a total of 22,989 agents. From these, (3,911/17.0%) were *CoNS*, (3,333/14.5%) *S. aureus*, (3,266/14.2%) *K. pneumoniae*, (2,960/12.9%) *Acinetobacter spp.* and (2,480/10.8%) *P. aeruginosa*. *E. coli* was the sixth most frequently reported pathogen, corresponding to (1,706/7.4%) of the notified microorganisms, followed by *Candida spp.* (1,516/6.6%).[18]

Considering the analysis of urine cultures, CAUTI are one of the most frequent bacterial infections that affect humans. The most prevalent microorganisms in urine cultures were *K. pneumoniae*, *Candida sp.* and *E. coli* with percentages of (23.1%), (13.5%) and (12.5%) respectively. This research corroborates a study conducted in a university hospital in *Natal* City, *Rio Grande do Norte* State, analyzed 997 positive urine cultures, and the etiologic agents that presented the most frequent results were *E. coli* (60.1%) followed by

Klebsiella spp. (32.7%) and *Candida spp*. (14%), among others of lower frequency. The profile of microorganisms is influenced by gender, age, pre-existing pathologies, and hospitalization sectors. Thus, the characterization of CAUTI in different hospital sectors can contribute to controlling measures to be taken for nursing care appropriate to microbial control.[19]

E. coli is a large and diverse group of bacteria found in the environment, food and intestines of people and animals. Although most strains of *E. coli* are harmless, some types of *E. coli* can cause diarrhea, while others cause urinary tract infections, respiratory disease, and pneumonia. Those enterobacteria can become Carbapenem-Resistant Enterobacteriaceae (CRE). Commonly in health settings, these infections occur in patients receiving treatment for other conditions. Thus, patients at higher risk for CRE infections are those requiring care with invasive devices such as mechanical ventilators, urinary or intravenous catheters, and those on prolonged antibiotic regimens.[17]

Other work performed in ICUs in the State of *Pernambuco* presents data similar to that found in our study, with the most isolated microorganism being the fungus *Candida albicans* (28.6%).[6]

Another considered aspect was the microorganisms identified in tracheal aspirates, with *A. baumannii* (29.2%), *P. aeruginosa* (26.6%), *S. aureus* (16.2%) and *K. pneumoniae* (11%) as the most prevalent microorganisms. Hence, a study with 22 patients hospitalized in an ICU of a university hospital presented similar data, since the microbiological analysis of tracheal aspirate showed that the most prevalent microorganisms were *A. baumannii*, present in (3/13.64%), *P. aeruginosa* in (3/13.64%) and *Candida spp*. in (4/18.18%).[20]

Acinetobacter is a group of gram-negative bacteria commonly found in soil and water, responsible for a variety of diseases, ranging from pneumonia, wound infections to sepsis. This bacterium can also "colonize" or live in a patient without causing infection or symptoms, especially in tracheostomy sites or open wounds. Occurrences of *Acinetobacter* infections usually happen in ICUs and healthcare facilities that care for critically ill patients. Patients on mechanical ventilation, prolonged hospitalization, those with open wounds or anyone with invasive devices such as urinary catheters are also more susceptible to infection with this microorganism. Besides, it may be spread to susceptible persons by person-to-person contact or contact with contaminated surfaces. Although there are many types of *Acinetobacter* and all can cause human disease, *A. baumannii* accounts for about 80% of the reported infections.[17]

Pseudomonas infections are caused by strains of bacteria found widely in the environment, with *P. aeruginosa* being the most common type responsible for causing infections in humans. In hospitals, where the most serious infections occur, this bacterium presents potentially serious and life-threatening risks and it can spread into the hands of healthcare professionals or equipment that is contaminated and not properly cleaned. These infections commonly occur in patients using mechanical ventilators, those with devices such as catheters, with surgical or burn injuries that cause blood infections and pneumonia. Unfortunately, *Pseudomonas* infections are becoming more difficult to treat due to increased resistance to antibiotics. Multiresistant *Pseudomonas* can be fatal for ICU patients. It is estimated that approximately 51,000 health-associated *P. aeruginosa* infections occur each year in the United States of America. More than 6,000 (13%) are drug-resistant, with about 400 deaths per year attributed to these infections.[17]

The control of HAIs must involve a multidisciplinary team since this is a complex task. Reducing infection rates can contribute to increased bed turnover, providing greater availability of ICU vacancies, as well as reducing the time of hospitalization, which will lead to economic problems reduction of public hospitals.[6]

CONCLUSIONS

By consolidating the identification of most predominant microorganisms in the aforesaid health service, an important step has been taken towards the comprehension of epidemiologically significant microorganisms. Given the comparison of data with the literature, it is clear that the microorganisms found in blood cultures, urine cultures, and tracheal secretions were similar to those found in other studies.

Hence, this study presents relevant data such as the number of microbiological exams requested, and the prevalence of pathogens involved in the cultures. It is suggested that it may serve as a basis for a broader study encompassing the sensitivity and resistance profile of microorganisms and also help to define strategies for a laboratory policy associated with the institution's medical protocols able to create mechanisms to decrease HAIs rates, as well as the length of hospital stay.

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