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Bacterial Contamination of the Mobile Phones of Health Professionals in a Hospital Unit in the State of Paraíba, Brazil

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ABSTRACT

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The study was conducted with the objective of evaluating the presence of microorganisms associated with infections in mobile phones of health professionals at a hospital unit in the state of Paraíba, Brazil. A sterile swab moistened with sterile saline was rotated over the external surface of the phone of 42 health professionals. The samples was inoculated on plates of Blood agar, MacConkey agar and Nutrient agar that were incubated aerobically at 37° C for 24-48 hours. The identification of isolated microorganisms was performed by standard microbiological procedures based on the microscopic and macroscopic aspects and conventional biochemical tests. All samples collected showed bacterial contamination. Coagulase-negative Staphylococci (CNS) was the most frequent bacterial agent (55%). *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Enterobacter* spp. and other agents were also isolated with variable frequencies. The high level of contamination indicates that the mobile device of these professionals may be serving as a reservoir and vehicle in the transmission of pathogenic agents both of hospital origin as community. To ensure that there is a reduction in the potential of the risks that these microorganisms can offer, it is necessary to the implementation of correct methods of disinfection of hands and own mobile phone.

Introduction

The healthcare-associated infections (HAI) correspond to a major problem faced by modern hospitals, since they are related to a high rate of morbidity and mortality of

hospitalized patients (Pina *et al.*, 2010). Thus constituting a negative charge both for patients and for public health (WHO, 2002; Mohammadi-Sichani and Karbasizadeh, 2011; Badr *et al.*, 2012). In the hospital environment the sources of pathogenic microorganisms that

may be related with the HAI are diverse. In addition to the instruments used in the provision of care, other objects capable of relaying microorganisms (fomites) are present and deserve attention. The direct handling of these objects without proper disinfection can make them reservoir and vehicles in the potential of microorganisms associated with infections.

The phones of health professionals can become an important vehicle in the transfer of agents associated with the HAI (Parhizgari, 2013). In hospitals, its use is extended in all departments, including the intensive therapy units that involve patients in critical condition, as the immunocompromised patients, who are very susceptible to these infections.

There are studies that show that the phones can be considered fomites in potential, once that give organisms an environment conducive to its development, such as constant heat and moisture (Brady *et al.*, 2006; Arora *et al.*, 2009; El-Ashry and El-Sheshtawy, 2014). In the clinical environment for always being at your hands can facilitate the dissemination of these pathogens, especially when there is a manipulation of the appliance in alternate moments in the provision of care, without the disinfection of the same or the proper hygiene of hands after handling (Tankhiwale *et al.*, 2012).

The control of HAI is not an easy task, since in addition to the institutional sphere, the individual care of each health professional are fundamental. Assuming the perspective that the phones are devices needed in our personal and professional routine, restrict its use is not a practical alternative. However, in spite of all the complexity in the control of HAI, the adoption of appropriate methods for cleansing and disinfecting the hands of mobile device alternatives have been shown to be effective in preventing the spread of these microorganisms

(Arora *et al.*, 2009; Trivedi *et al.*, 2011; Badr *et al.*, 2012).

It is necessary to achievement of investigative work in partnership with the health institutions, once, to be drawn control goals it is necessary that each institution has knowledge on the most prevalent pathogens that may be associated with infections. In addition to the awareness of health professionals about the importance of good practice of hand washing and disinfection of mobile phones, associated with the containment of its use in more critical environments are relevant attitudes to be taken.

The present study aimed to assess the presence of microorganisms associated to HAI in mobile phones from the healthstaff in a hospital unit in the state of Paraíba, Brazil.

Materials and Methods

Place of study and sample collection

The study was conducted at the Hospital Regional Senador Rui Carneiro, located in the municipality of Pombal, Paraíba, Brazil, in the period from February to March 2016. The samples were collected from the mobile phones of 42 health professionals, of which 20 were nursing technicians, 15 nurses, 2 nursing auxiliaries, 3 doctors, 1 physiotherapist and 1 social worker, working in 8 departments: intensive care unit, medical clinic, maternity, surgical center, red area, center of materials and sterilization, medical emergency and social service.

The samples were collected at previously established times with all the professionals who agreed to participate in the study. The procedures for sample collection were performed in a location donated by the direction of the hospital, so that they do not

interfere with the routine of the institution and for which there is direct contact with patients.

The samples were collected by means of moistened swabs in sterile saline solution at 0.9% by the technique of bearing on the surface of the entire mobile device (screen, keyboard, side, rear cover and microphone). Subsequently, the swabs were placed immediately into tubes containing BHI broth (Brain Heart Infusion), which was used as a means of transport (Ankinyemy *et al.*, 2009). The tubes were duly identified, chilled and transported within a maximum period of 2 hours for the Microbiology Laboratory of the Academic Unit of Biological Sciences of the Health and Rural Technology Center of the Federal University of Campina Grande, Patos, Paraíba, Brazil, where they were incubated aerobically at 37 °C for 24 hours.

Primary isolation

In the laboratory, after the incubation period, with the turbidity of the BHI, the inoculum was seeded onto plates containing the following culture media: Blood Agar (supplemented with 5% defibrinated sheep blood), MacConkey Agar and Nutriente Agar, which were subsequently incubated aerobically at 37 °C for 24 - 48 hours.

Characterization and identification

The microorganisms isolated were identified by means of microbiological standards procedures based on macroscopic aspects (appearance and morphology of the colonies), microscopic aspects (Gram staining) and conventional biochemical tests.

Gram-positive cocci were identified using reactions of hemolysis, production of catalase and coagulase. Gram-negative bacilli were identified through the fermentation of lactose and other biochemical tests inoculating the

isolates in the following ways: TSI (Triple Sugar Iron), Simmons citrate, Gelatine, MR-VP (Methyl Red and Voges Proskauer), Tryptone soy broth, and SIM (Sulfide, Indol, Motility).

Ethical positioning

All professionals agreed to participate in the study by signing an informed consent form, in which were outlined the objectives of the study and other additional information, such as the voluntariness of participation, confidentiality and restriction of the use of the results obtained only for scientific purposes.

Before the realization of study, this project was submitted to the evaluation of the local Committee for Ethics in Research obtaining a positive opinion for its realization.

Results and Discussion

Forty-two professionals participated in the study. The greater portion of the sample was composed by the nursing staff (37/88%). The category is the largest part of the framework of staff in all departments of the health institution. By virtue of its own dynamic labor, it is this category that enters into direct contact and more time with patients. The distribution of the samples collected in accordance with the department of health professionals' participants in the present study are described in Table 1.

All samples collected from the phones in this study presented bacterial growth, being isolated two or more bacterial species in the same. The rate of contamination of mobile devices evaluated was 100%, greater than in all similar studies used as reference. A comparative between the contamination rate observed in this study with similar studies carried out around the world are described in Table 2.

The bacterial contamination observed in the mobile phones of health professionals was similar to that reported by Bhat *et al.*, (2011) where the 204 phones evaluated, 201 (98.53%) presented bacterial growth. In comparison to the present study, Arora *et al.*, (2009) reported the lowest contamination, where the 160 mobile phones evaluated, only in 65 (40.62%) was observed bacterial growth.

In this study, the isolated microorganisms most commonly associated with HAI were: coagulase-negative Staphylococcus, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterobacter* spp. All other microorganisms isolated in this study are listed in Table 3.

The most frequent microorganisms in the sample belonged to the genus Staphylococcus: Coagulase-negative Staphylococci (CNS) (55%) and *Staphylococcus aureus* (14%). The CNS are bacterial agents isolated with greater frequency of mobile phones for health professionals. This was confirmed by Karabay *et al.*, (2007), Ulger *et al.*, (2009), Bhat *et al.*, (2011), Mohammadi-Sichani and Karbasizadeh (2011), Badr *et al.*, (2012) and Parhizgari *et al.*, (2013).

Staphylococci have humans as its main reservoir, being present asymptotically and composing their microbiota of the skin, throat, nasal cavities and intestine (Santos *et al.*, 2007). These microorganisms can be spread through direct contact of its bearer with surfaces of objects. Its greatest frequency in this study was expected, and is explained by the fact that routinely the mobile device comes in contact with the skin, which is one of the habitats of species of the genus. This direct contact is possibly favoring the transfer of these microorganisms for mobile phones (Goel and Goel, 2009).

Staphylococcus aureus was indicated by Nogueira *et al.*, (2009), as the main cause of infections of the bloodstream and one of the main associated with surgical site infections. Goel and Goel (2009) stated that the staphylococcal infections can never be eradicated because of the condition of man is one of the main hosts of microorganisms of the genus.

In our study, *Klebsiella pneumoniae*, *Escherichia coli*, *Enterobacter* spp. And *Pseudomonas aeruginosa*, which are also commonly associated to HAI, were isolated from 19, 12, 24 and 7% of mobile phones, respectively. Other studies performed in hospitals in other countries also have isolated these microorganisms phones of health professionals in less frequently. In Iran, Mohammadi-Sichani and Karbasizadeh (2011) isolated *Enterobacter* spp., *E. coli*, *Klebsiella* spp. and *Pseudomonas* sp., in 1.1; 0.4; 0.4 and 0.4%. In India, Tambekar *et al.*, (2008) isolated *P. aeruginosa*, *E. coli* and *K. pneumoniae* in 15, 11 and 10%, respectively. In Turkey, Karabay *et al.*, (2007) isolated *E. coli*, *P. aeruginosa* and *K. pneumoniae* in 3.6; 1.8 and 0.9%.

The bacteria *K. pneumoniae* was indicated by Nogueira *et al.*, (2009) as a microorganism more associated with pneumonia and one of the main causes of urinary tract infections and surgical site. The treatment of infections caused by bacteria of the genus *Klebsiella* has become difficult because some strains carry plasmids encoders betalactamase enzyme, which confers to the micro-organism resistance to antibiotics of the lactam class (Menezes *et al.*, 2007).

In a study of prevalence of infections carried by Blatt and Miranda (2005) in a hospital in Fortaleza - CE, *E. coli* and *Enterobacter* spp. were the most prevalent microorganisms as causative agents of infections of the urinary

tract. Species of the genus *Enterobacter* are intrinsically resistant to several classes of antimicrobials (Paterson, 2006), which hinders your treatment. *Pseudomonas aeruginosa* is responsible for infections in various sites of the human body and the isolated strains are often resistant to several classes of antimicrobials (Fuentefria *et al.*, 2008).

health professionals were grouped according to the department in which these professionals act (Table 4). Of the departments assessed, two involve patients more susceptible to infections, due to the invasiveness of the procedures performed or the severity of patients admitted to these sites, which are the intensive care unit and surgical center.

All microorganisms isolated from phones of

Table.1 Number of samples of phones distributed by departments of health professionals' actions in a hospital unit in the state of Paraíba, Brazil

Departament	N	%
Intensive Care Unit	14	33.3
Medical Clinic	13	30.9
Maternity	5	11.9
Surgical Center	3	7.1
Red area	3	7.1
Material and Sterilization Center	2	4.7
Urgency	1	2.3
Social Service	1	2.3
Total	42	100

Table.2 Comparison between the rates of contamination of mobile phones in a hospital environment, health professionals in various studies

Authors	N° of Samples	Contamination Rate (%)
Karabay <i>et al.</i> , (2007)	122	90.9%
Arora <i>et al.</i> , (2009)	160	40.62%
Bhat <i>et al.</i> , (2011)	204	98.53%
Tambe and Pai (2012)	120	82.5%
El-Ashry and El-Sheshtawy (2015)	200	92.5%
Sharma and Jhanwar (2015)	40	85%
Present study	42	100%

Table.3 Bacterial agents isolated from mobile phones of health staff in a hospital in the state of Paraíba, Brazil

Bacterial agents isolated	No. of samples positive for the isolated microorganism	Frequency between samples (%) (n=42)
Gram-positive bacteria		
Coagulase-negative Staphylococci	23	55
<i>Staphylococcus aureus</i>	6	14
<i>Corynebacterium</i> spp.	2	4
Other Gram-positive bacilli	22	52
Gram-negative bacteria		
<i>Klebsiella pneumoniae</i>	8	19
<i>Escherichia coli</i>	5	12
<i>Enterobacter</i> spp.	10	24
<i>Citrobacter diversus</i>	8	19
<i>Pseudomonas aeruginosa</i>	3	7
Other G.N.B.* Non-fermenters	11	26

*Gram-negative bacilli

Table.4 The number of samples positive for the microorganisms isolated from phones of health staff according to their departments in a hospital in the state of Paraíba, Brazil.

		Departments							
		CM*	ICU*	MAT*	SC*	MSC*	RA*	ME*	SS*
Isolated microorganisms	Coagulase-negative Staphylococci	8	10	-	-	1	2	1	1
	<i>Staphylococcus aureus</i>	1	2	1	2	-	-	-	-
	<i>Klebsiella pneumoniae</i>	3	2	2	1	-	-	-	-
	<i>Escherichia coli</i>	4	-	-	1	-	-	-	-
	<i>Pseudomonas aeruginosa</i>	1	2	-	-	-	-	-	-
	<i>Enterobacter</i> spp.	4	3	1	1	-	1	-	-
	<i>Citrobacter diversus</i>	2	3	2	-	-	1	-	-
	B.F.N.** not fermenters	2	5	1	-	1	-	1	1
	<i>Corynebacterium</i> spp.	1	-	-	-	-	-	-	-
	Other Gram-positive bacilli	8	9	4	-	2	2	1	1

* CM: Medical Clinic; ICU: Intensive Care Unit; MAT: Maternity SC: Surgical Center; MSC: Materials and Sterilization Center; RA: Red Area; ME: Medical Emergency; SS: Social Service. ** Gram-negative bacilli;

As to the risks of HAI, the problem is more serious in the ICU. In this environment the patient is more exposed to the risk of infections, in view of their clinical condition and the variety of invasive procedures routinely performed (Lima *et al.*, 2007). Thus, without proper disinfection, occasionally the mobile phone of professionals working in these departments can become a vehicle in the transmission of pathogens via: mobile device - health care professional - patient susceptible.

The main objective of this study was to verify the presence of microorganisms commonly associated to infections from the mobile phone of health professionals. The culture at the hands of these professionals could not be performed, which may have been one of the limitations of the study. However, considering the direct handling and continuous mobile device it is possible to assign their contamination at the hands of these professionals. The threat of dissemination of these microorganisms is valid, since all mobile phones evaluated in this study showed bacterial contamination of species associated to HAI. When used in an excessive and in environments that contain immunocompromised patients, such as ICU's or other places in which they perform invasive procedures, the mobile phone of these professionals can act as a vehicle disseminators of pathogenic agents.

Restrict the use of the appliance is not something feasible, since one of the benefits of this electronic device is fast communication between the departments of the institution. But if there is no moderation in the use associated to a routine disinfection of hands and the appliance, it can become a means of communication prejudicial to the institution.

Universally, standards of hygiene are pre-requisites for a healthy life. In the hospital

environment, good hygiene practices should be followed by the most rigid form possible, because it is a place of provision of care and protection to human health. Health professionals should be aware that their devices can contain and convey harmful micro-organisms, which can be disseminated both in and outside the hospital environment. When it comes to the HAI, prevention will always be the best attitude to be taken. Strategies for prevention, hygiene routine of mobile phones with alcoholic solutions or other substances disinfectants can reduce the risk of cross-contamination, then, is something that should be treated as a priority in health institution.

In this perspective, the results of this work can be used in educational campaigns along with the health staff through the elaboration of informative material emphasizing the importance of washing hands after using the mobile phone, raising awareness about the possible role of mobile device as a vehicle of different pathogens in both hospital environment as well as for the community pool.

In addition, there may be implemented a specific protocol for disinfection of hands and mobile devices to control the dissemination of these pathogens that could be deployed by the institution under study.

The phones of the health staff studied are reservoirs of microorganisms, including species of medical importance because for being associated healthcare-associated infections (HAI), and for this reason, may be assuming a status of vehicle of pathogenic agents in the hospital environment.

This way are necessary actions of awareness of these professionals in relation to good practice and correct methods of hand hygiene and disinfection of own mobile phone for which there is reduction of potential

biological risks that these microorganisms can bring.

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