

BACTERIAL AND FUNGAL CONTAMINATION OF MOBILE PHONES BELONGING TO THE HEALTH TEAM OF A HOSPITAL IN MINAS GERAIS STATE

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ABSTRACT

This is a bacteriological analysis that aimed to determine the most common bacterial and fungal species on the mobile phones, and the oral and nasal cavities of the healthcare team of a hospital in Minas Gerais state. Questionnaires were applied and samples of secretions from the oral and nasal cavity, and used mobile phones were collected. The microorganisms were identified and the susceptibility to antimicrobials was analyzed. In 60 samples, *Staphylococcus aureus* was found in 40% of the professionals and 6.7% of this bacterium was present on the mobile phones. All isolates were classified as resistant to penicillin and 3.57% to oxacillin. Fungi were not isolated. The mobile phones used in health centers can become vehicles for infectious agents and be potential vectors for transmission of infections, in case they are not decontaminated after being used.

Keywords: Cross Infection. Bacteria. Mobile Phones. Contamination.

INTRODUCTION

Nosocomial diseases are the most common and relevant complications among hospitalized patients. In Brazil, it is estimated that 5% to 15% of people admitted to hospital contract an infection, which adds, on average, five to ten days of hospitalization and increases spending on diagnostic and therapeutic procedures^(1,2). Combined with this fact, technological advances have intensified the complexity of care, to the extent that the procedures performed within the health institutions are invasive and break the natural barriers of defense, exposing users to the risk of acquiring cross infections^(3,4).

The prolonged time of hospitalization intensifies the patient's vulnerability to infections. Depending on the subject's state of immunosuppression, the disruption of the skin's natural barriers and mucous membranes and the intensification of the manipulation of the patient for therapeutic purposes and diagnoses, the handling of objects by contaminated hands of healthcare team or careers, can spread infectious

agents.

The places where the items / utensils / materials are handled or processed and the people handling them can cause iatrogenesis, due to contact with susceptible hosts. Among the mechanisms of infection transmissions in hospital environments, contaminated hands of health-related professionals and workers act as an important vehicle of dissemination. Mobile phones can be potential fomites for the transmission of infections. Some pathogens involved in serious diseases, such as *Pneumococcus*, have already been isolated, many times, on mobile phones⁽³⁻⁷⁾.

The risk arises from the manipulation of objects in moments interspersed with care, the non-decontamination of hands and objects, the absence of personal protective equipment to ensure the blocking of the transmission of germs or from the violation of good health practices⁽¹⁻⁵⁾.

The presence of pathogenic bacteria on mobile phones in intensive care units (ICU) has been already described, and studies with cultures from the mouthpieces of telephones allocated in hospitals showed that 47% of the devices could

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carry potentially pathogenic bacteria. However, disinfection is capable of reducing equipment contamination; it is also possible to change the material used to manufacture them or even the design of the mouthpiece⁽⁶⁻⁸⁾.

Given the fact that mobile phones are part of the daily lives of individuals and that health professionals insert them in their work activities in order to facilitate the communicative capacity inside or outside of hospitals, the microbiological analysis of mobile phones is the object of the present investigation.

The present investigation was conducted aiming: 1) to help the identification of potential sources of transmission of microorganisms in the hospital environment; 2) to identify whether the mobile phone can be considered a habitat for bacteria and what species could be hosted on these devices, 3) to alert healthcare team and workers who act in hospital areas regarding the adoption of preventive behavior with respect to the use of mobile phones and the caution needed when using them in the hospital; 4) contribute to the identification of forms of indirect transmission of microorganisms and the possibility of reducing treatment and hospitalization costs due to iatrogenesis triggered by the inappropriate use of mobile phones in hospitals and 5) to support control and prevention actions related to the transmission of pathogens that can cause infection inside and outside of hospitals and assist in the decision making, through microbiological evidence. The importance of identifying places where microorganisms could be hosted, as in the case of the mobile phone, and alert the health team to adopt preventive behaviors in relation to its use in hospitals constitute the major contributions of the research.

In this study, it was found whether mobile phones can transport microorganisms, what the main species of bacteria and fungi that can be isolated from these devices are and whether these microorganisms are compatible with those found in the nasal and oral cavities of the healthcare team of a hospital in a city in Minas Gerais state, Brazil.

METHOD

This is an exploratory and cross-sectional research conducted in a general hospital of a city in the state of Minas Gerais.

The population studied was composed of 60 members of the healthcare team, and the following inclusion criteria were adopted: the subject could be of both sexes, should be over 21 years of age, work as a nurse, technical nurse, auxiliary nurse, physician, nutritionist and physical therapist, be in contact with patients, own a mobile phone and formalize his or her participation by signing the informed consent form when required.

The potential participants were invited as non-remunerated volunteers and given explanations about the purposes of the investigation and how they would participate. Appointments were scheduled individually, with the agreement of all participants, so that the data could be collected in their own work environment, taking into consideration the strict storage procedures and exposure time of the samples. The data were collected between May and July, 2009, from 60 participants who met the inclusion criteria.

A pilot trial with five people of the community, randomly selected, was performed and allowed for the standardization of the method and techniques used. The samples were collected by means of swabs, from the following locations: keyboards, sides and microphone of the mobile phones, as well as from the mucosa of the oral cavity and the nasal mucosa of the participant. After collection, the swabs were placed in labeled glass tubes, containing sterile peptone saline. The tubes were kept refrigerated (cooler with ice) and sent, along with a questionnaire, within two hours, to the Microbiology Laboratory of the Federal University of the Vales do Jequitinhonha e Mucuri (UFVJM), where the samples were processed.

The microorganisms were isolated and identified. The samples collected were put in non-selective culture media (Sabouraud agar supplemented with chloramphenicol) and selective culture media (Mannitol salt agar, Mitis, Eosin-Methylene Blue - EMB) and incubated for 18-48 hours, at 35 °C. The isolated colonies were analyzed through light microscopy after Gram staining and the prevalent fungal and bacterial species were identified through biochemical tests.

The *in vitro* susceptibility of the prevalent bacterial species was determined through the disk diffusion test, in accordance with the document M2-A8 "CLSI" (Clinical Laboratory Standards Institute) (2003)⁽⁹⁾ for the antimicrobial drugs: penicillin G, oxacillin, erythromycin, clindamycin, ciprofloxacin, amikacin, netilmicin, gentamicin, tobramycin and tetracycline.

A total of three to five colonies of each bacterial species were identified, redistributed in pure cultures, incubated for 24-48 hours at 35 ° C and transferred to a tube containing 4.5 ml of sterile saline, to be used in the preparation of a suspension whose turbidity was adjusted to coincide with that of the 0.5 McFarland standard solution, equivalent to 1 to 2 x 10⁸ CFU / mL. After preparation, the bacterial suspension was plated on Mueller-Hinton agar. The disks with antibiotics were placed on the dry surface of the Mueller-Hinton agar plate, at predetermined locations, and pressed against the plate to ensure complete contact with the agar surface. After 16 to 18 hours of incubation, zones of growth

inhibition were measured in millimeters, and microorganisms classified as sensitive, intermediate or resistant to antibacterial agents were tested.

All legal and ethical requirements for research involving humans were met, and the data were collected only after approval of the project by the Ethics and Research Committee (Protocol 019/09).

RESULTS AND DISCUSSION

Sixty professionals participated in the study. Nursing was the professional category with the highest number of participants (54). Due to the dynamics of their work, they are the ones who are more often in direct contact with patients and constitute the majority of employees in all sectors of the institution. The distribution of the professionals participating in the study, by category and the work sector, is displayed in Table 1.

Table 1. Characterization of the professionals participating in the study, by hospital sector and professional category.

Sector in the Institution where the mobile phone was used	n.	%	Professional category of the mobile phone's owner	n.	%
Neurological Clinic	19	31.7	Technical Nurse	39	65
Medical Clinic	15	25	Nurses	14	23.3
Surgical Clinic	10	16.7	Physicians	3	5
Hemodialysis	8	13.3	Physiotherapist	2	3.3
Intensive Care Unit	7	11.7	Nutritionist	1	1.7
Emergency Care	1	1.7	Auxiliary Nurse	1	1.7
Total	60	100	Total	60	100

Regarding the isolated microbial samples, 33.3% of the professionals carried the *Staphylococcus aureus* in the nasal region and 6.7% had this bacterium on their mobile phones. The *S. aureus* was isolated from both the mobile phone and the nasal region of two professionals. Other two had this microorganism only on their mobile phones. The *Streptococcus* of the group *mitis / salivarius* was isolated in 100% of the samples from the oral region. The *Streptococcus*

of the group *mitis / salivarius* and the enterobacteria were isolated from the mobile phone of 8.3% and 1.7% of the professionals, respectively. *Candida* fungi were not isolated. The bacterial species identified and the place of isolation (mobile phone, nasal or oral region), by hospital sector and professional category, are displayed in Table 2.

Table 2: Distribution of the bacterial species by region of collection, sector of collection and professionals who presented growing pathogen on their mobile phones and / or nasal region.

Criteria analyzed		Isolated Species				
		Staphylococcus aureus	Streptococcus mitis/salivarius	Enterobacteria	Candidaspp	
Place of collection	Mobile phone	4	5	1	-	
	Nasal Region	24	-	-	-	
	Oral region	-	60	-	-	
	Surgical Clinic	6	1	1	-	
Sector in the Institution	Neurological Clinic	6	-	-	-	
	Medical Clinic	5	1	-	-	
	Intensive Care Unit	3	2	-	-	
	Hemodialysis Sector	3	1	-	-	
	Emergency Care Sector	1	-	-	-	
	Subtotal	24	5	1		
Professional Category	Physician	1N				
	Nurse	6N, 1M	3M			
	Technical Nurse	12N, 1NM	1M			
	Auxiliary Nurse	2N, 1M, 1NM		1M		
	Physiotherapist	1N				
	Nutritionist	-	1M			

Authors' note: N= nasal region, M=mobile phone, NM=nasal region and mobile phone

It is known that nosocomial infections represent a serious medical and social problem^(1,4,6); knowing, preventing and controlling them is a challenge to be faced⁽¹⁰⁾. Among the microorganisms associated with the etiology of these infections, the *S. aureus*, highlighted in this research, remains an important pathogen, accounting for over 30% of the cases of cross infections. In hospitals, the reservoirs of the microorganism in question are represented by colonized patients, employees and the environment itself. The *S. aureus* is an opportunistic microorganism found in the mucous membrane microbiota (oral and nasal)

of human beings⁽¹¹⁾. This pathogen causes serious infections when in contact with the human body. There is an increasing number of patients with their defenses reduced, whether due to old age, multiple underlying diseases or immunosuppressive therapies. As contributing factors, it is noteworthy the increasing use of invasive procedures, such as intravenous catheters - central and arterial -, dialysis, mechanical ventilation and surgical interventions in patients, who a few years ago could not afford it^(10,12,13).

About 50% of healthy people carry the *S. aureus* in their nasal cavities and throat⁽⁹⁾. Such

microorganism was identified in the microbiota of the healthcare team of the hospital in question; 40% (24) of the professionals carried the *S. aureus* in their nasal region, whereas 6.7% (4) of the professionals analyzed carried it on their mobile phones. In 24 (40%) of the 60 (100%) samples collected, the *S. aureus* grew, being 20 (33.3%) from the nasal region. From this sampling, four come from professionals of the medical clinic (6.7%), five of the neurological clinic (8.3%), five of the surgical clinic (8.3%), three of hemodialysis (5%) and three of the ICU (5%). Two (3.3%) contain the microorganism on the phone and the nasal region - one of the medical clinic and other of the neurological clinic. In two samples (3.3%) the *S. aureus* was found only on the mobile phones.

In the present study, the *S. aureus* was isolated in the nasal cavity in only one of the physicians (Table 2).

There is evidence of isolation of *S. aureus* on bed rails, handles, bedside table, buttons of the

infusion pump and surgical gowns in an intensive care unit of a university hospital in 48 samples⁽¹⁴⁾. The authors found that 60 (4%) of the bacterial samples were resistant to methicillin with widespread environmental contamination by methicillin-resistant *S. aureus* (MRSA)⁽¹⁴⁾.

Several factors relating to each element of the fundamental ecological triad (host-agent-environment) contribute to the prevalence and control of these types of infection. Since man is the main reservoir of *S. aureus*, cross-infection is common among humans, occurring via air, or as a result of direct contact with people and inanimate objects - as the object of this research, the mobile phone⁽¹⁰⁻¹²⁾.

The antibiogram was performed for twenty-eight (28) isolates of *S. aureus*, due to the significant growth in the samples, along with its prevalence in the cross infections.

Table 3 displays the criteria for classification of the microorganisms as resistant, intermediately resistant or sensitive.

Table 3. Reference values of the inhibition zones (mm) for classification of the microorganisms as resistant, intermediate or sensitive (CLSI document M2-A8, 2003).

Antibiotic	Resistant	Intermediate	Sensitive
Penicillin G	≤28	*	≥29
Oxacillin	≤10	11 to 12	≥13
Erythromycin	≤13	14 to 22	≥23
Clindamycin	≤14	15 to 20	≥21
Ciprofloxacin	≤15	16 to 20	≥21
Amikacin	≤14	15 to 16	≥17
Netilmicin	≤12	13 to 14	≥15
Gentamicin	≤12	13 to 14	≥15
Tobramycin	≤12	13 to 14	≥15
Tetracycline	≤14	15 to 18	≥19

The following results were obtained: resistance to Penicillin G in 100% of the isolate of *S. aureus*. One isolate (3.57%) showed small

values of inhibition zone for oxacillin, other (3.57%) classified as intermediate and the remainder (92.86%) were sensitive to this drug.

Eight (28.57%) isolates were resistant to Erythromycin, fifteen (53.57%) intermediate and the remainder was sensitive (17.86%). One (3.57%) isolate was resistant to Clindamycin, twelve (42.86%) intermediate and fifteen (53.57%) were sensitive to this drug. Two isolates (7.14%) were resistant to Ciprofloxacin, seven (25%) intermediate and the remainder was sensitive (67.86%). Eight (28.58%) isolates were resistant to Amikacin, seven (25%) intermediate and thirteen (35.71%) sensitive. Three (10.71%) were resistant to Netilmicin and the remaining

twenty-five (89.29%) were classified as sensitive. Four (14.29%) were resistant to Gentamicin, fifteen (53.57%) were classified as intermediate and nine (32.14%) as sensitive. Eighteen (64.29%) isolates were resistant to Tobramycin, six (21.43%) intermediate, and four (14.28%) sensitive. Regarding Tetracycline, ten (35.51%) were resistant, three (10.71%) were intermediate and the remainder was sensitive (53.78%). The most effective antibiotic against *S. aureus* was Oxacillin, followed by Netilmicin and Ciprofloxacin (Figure 1).

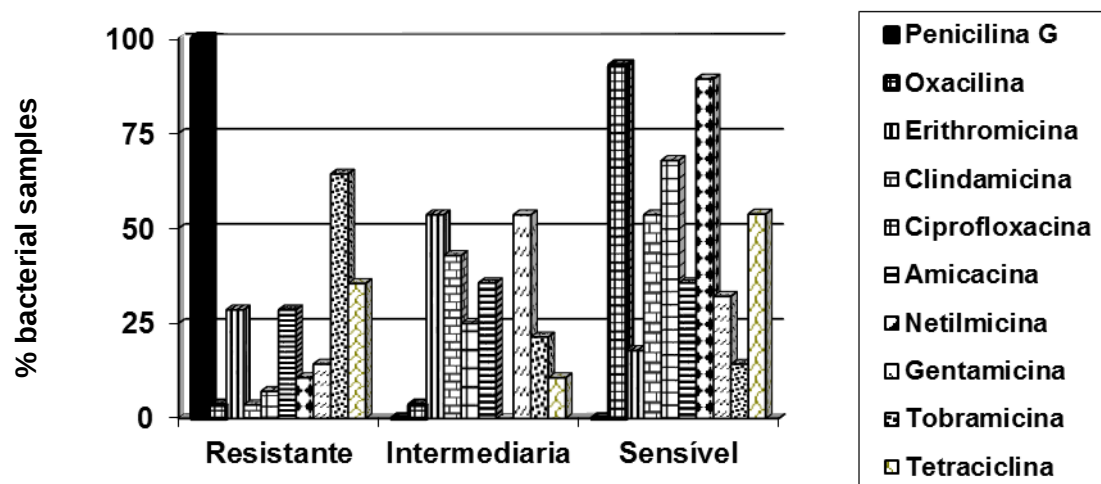


Figure 1. Profile of susceptibility of *S. aureus* to various antimicrobial drugs

Infections caused by antibiotic-resistant pathogens pose a challenge to medicine and the processing of hospital-related items⁽¹⁵⁾, since pathogenic microorganisms may gain resistance to any antibiotic that once was effective, thus leading to an uncontrolled increase in epidemics caused by bacterial diseases that cannot be treated⁽¹⁶⁻¹⁸⁾.

All isolates showed some resistance to at least one antibiotic. Penicillin was the antibiotic with the lowest effectiveness (100% of resistant samples), followed by tobramycin (64.29% of resistance). Since the introduction of penicillin G to the newer beta-lactam antibiotics, there are records of selection of resistant bacteria, caused by the intense, abusive and indiscriminate use of antimicrobials. Resistance genes can be transferred between bacteria that inhabit the hospital environment, with subsequent selection of species resistant not only to the drug administered, but, simultaneously, to other drugs

(multi-resistant bacteria), producing gloomy expectations for the future, if urgent measures are not taken⁽¹⁹⁻²¹⁾.

In Brazil, staphylococci, the *S. aureus* and the *S. epidermidis*, prove to be resistant to penicillin G, ampicillin and amoxicillin in more than 70% of the strains, whether in hospital environment or in the community, and the use of these antibiotics is no longer indicated for the treatment of staphylococcal infections, even if benign and even if they come from outside of the hospital. Moreover, these germs have shown high rates of methicillin resistance in Brazilian hospitals, which has been happening in other countries⁽²²⁻²⁴⁾.

FINAL CONSIDERATIONS

The results of the study show bacterial contamination of mobile phones; they also stress

that secretions from the oral and nasal cavities of the hospital's healthcare team can spread infectious agents and disseminate microorganisms. Bacterial species multi-resistant to routinely used antibiotics, such as the *S. aureus*, can be transmitted to immunosuppressed patients and individuals of the community. Viable strategies for the control of multi-resistant staphylococci include the universal measures of infection control (for

instance, the adoption of hygiene measures, such as washing hands with soap and water, wearing gloves and caution with wastes and secretions), epidemiological surveillance, blocking for the modes of transmission (indirect contact), judicious use of glycopeptides and treatment of infected patients. Therefore, such actions must be carried out to control microbial growth and reduce the development of various infectious diseases.

CONTAMINAÇÃO BACTERIANA E FÚNGICA DOS TELEFONES CELULARES DA EQUIPE DE SAÚDE NUM HOSPITAL EM MINAS GERAIS

RESUMO

Análise microbiológica que objetivou determinar as principais espécies bacterianas e fúngicas presentes nos aparelhos celulares e nas cavidades bucal e nasal da equipe de saúde, de um hospital de uma cidade do interior de Minas Gerais. Foram aplicados questionários e coletadas amostras de secreção da cavidade oral, nasal e do aparelho celular em uso. Os microrganismos foram identificados, e a susceptibilidade a antimicrobianos foi avaliada. Em 60 amostras coletadas, 40% dos profissionais foram portadores de *Staphylococcus aureus*, e 6,7% apresentaram esta bactéria no celular. Todos os isolados foram classificados como resistentes à penicilina e 3,57% à oxacilina. Não foram isolados fungos. Os aparelhos celulares utilizados em estabelecimentos de saúde são passíveis de veicular agentes infecciosos e constituir fômites potenciais na transmissão de infecções, se não descontaminados após o uso.

Palavras-chave: Infecção hospitalar. Bactérias. Telefones Celulares. Contaminação.

CONTAMINACIÓN BACTERIANA Y FÚNGICA DE LOS TELÉFONOS CELULARES DEL EQUIPO DE SALUD EN UN HOSPITAL EN MINAS GERAIS

RESUMEN

Análisis microbiológico que tuvo el objetivo de determinar las principales especies bacterianas y fúngicas presentes en los teléfonos móviles y en las cavidades bucal y nasal del equipo de salud de un hospital de una ciudad del interior de Minas Gerais. Se aplicaron cuestionarios y se recogieron muestras de secreción de la cavidad oral, nasal y del teléfono móvil en uso. Los microorganismos fueron identificados y la susceptibilidad a antimicrobianos fue evaluada. En 60 muestras recogidas, el 40% de los profesionales fueron portadores de *Staphylococcus aureus* y el 6,7% presentaron esta bacteria en el móvil. Todos los aislados fueron clasificados como resistentes a la penicilina y el 3,57% a la oxacilina. No fueron aislados hongos. Los teléfonos móviles utilizados en los centros de salud son pasibles de conducir agentes infecciosos y constituir fômites potenciales en la transmisión de infecciones, si no descontaminados después del uso.

Palabras clave: Infección Hospitalaria. Bacterias. Teléfonos Celulares. Contaminación.

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Submitted: 20/09/2012

Accepted: 05/11/2013