



Mobile phones usage in hospital settings and the risk of bacterial contamination

Uso de celulares no ambiente hospitalar e o risco de contaminação bacteriana

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ABSTRACT

This work aims to evaluate the characteristics of the cell phone by employees, students and health professionals and investigate the relationship with the number and type of microorganisms present on the phone. Sociodemographic data and information on cell phone use were collected, in addition to the microbiological assessment of the phones. The data were analyzed in SPSS, through descriptive statistics of the variables. Among the 50 study participants, 82% were female, 96% used their cell phones at work and 70% performed some type of asepsis. Regarding microbiological collection, there was bacterial growth in 68% of cell phones, whose most isolated bacterium was negative coagulase *Staphylococcus* (47%). In addition, there was a growth of more than 100.000 CFU/mL in the cell phones of residents (26.5%) and undergraduates (23.5%). It is concluded that the use of the cell phone during the working day is frequent, which may be related to the number of contaminated devices.

Keywords: Bacteria. Biological Contamination. Cell Phone Use. Cross Infection.

RESUMO

Este trabalho se propõe a avaliar as características do celular por funcionários, estudantes e profissionais de saúde e investigar a relação com o número e tipo de microrganismos presentes no telefone. Foram coletados dados sociodemográficos e informações sobre o uso do celular, além da avaliação microbiológica dos telefones. Os dados foram analisados no SPSS, através de estatística descritiva das variáveis. Dos 50 participantes do estudo, 82% eram do sexo feminino, 96% usam o celular no trabalho e 70% realizavam algum tipo de assepsia. Referente à coleta microbiológica, houve crescimento bacteriano em 68% dos celulares, cuja bactéria mais isolada foi o *Staphylococcus* coagulase negativa (47%). Além disso, houve crescimento de mais de 100.000 UFC/mL nos celulares dos residentes (26,5%) e acadêmicos (23,5%). Conclui-se que o uso do celular durante a jornada de trabalho é frequente, o que pode haver relação com o número de aparelhos contaminados.

Palavras-chave: Bactérias. Contaminação biológica. Infecção hospitalar. Uso do telefone celular.

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INTRODUCTION

Healthcare-associated infections (HAIs) represent a major threat to public health worldwide, and can directly influence patient safety^{1,2}. As a result of this health problem, some factors are mentioned, such as the increase in hospital stay, the increase in microbial resistance and the increase in financial expenses, whether for diagnosis or medication¹⁻³. HAIs develop during or after hospitalization and are often the result of cross contamination by inanimate surfaces or through contaminated hands of health professionals²⁻⁴.

Cell phones have been frequently used in clinical environments, becoming essential in healthcare settings, since professionals and undergraduates use it countless times, either for communication and/or as information source^{5,6}. In addition, there are several health applications, which have become increasingly popular in cases of fast research^{5,7}.

However, its use in a hospital environment can make the cell phone a potentially promising vehicle for the cross-transmission of microorganisms^{8,9}. In Brazil, a study carried out in a hospital in Recife, found bacterial contamination in 88% of the cell phones of professionals working in the operating room sector¹⁰. Worldwide, the rate of bacterial colonization in mobile telephone devices was 74% in a hospital in Australia⁵, 60% in Northern Ireland⁷, 81.8% in India¹¹ and 94.2% in Ethiopia¹².

It is known that different types of microorganisms can be isolated on the surface of the mobile telephone device¹¹⁻¹⁴. In some cases, they are bacteria and fungi that belong to the human microbiota, being considered non-pathogenic under normal circumstances; however, they can be potentially pathogenic when they affect immunocompromised patients, leaving them vulnerable to develop some infectious processes¹⁵.

Bearing in mind that the cell phone is considered a potential reservoir for microbial contamination and that its use in the hospital

environment can be a stimulus for the transmission of pathogenic microorganisms, the objective of this study was to evaluate the characteristics of the use of cell phones by employees, students and health professionals of a teaching hospital in a small town of State of Rio Grande do Sul (RS) and investigate the relationship with the number and type of microorganisms present on the telephone.

METHODOLOGY

POPULATION AND SAMPLING

A cross-sectional and observational study was carried out in order to identify the presence of bacterial contamination in the cell phones of health professionals, workers and undergraduates in sectors of a teaching hospital in a small town of Rio Grande do Sul, Brazil. Located in the Vale do Rio Pardo region, this hospital is considered medium-sized and high complexity, being a reference in cardiology, traumatology, orthopedics and high-risk pregnant women.

The research was divided into two parts, the first was the application of a questionnaire and the second, a collection and bacterial evaluation of cell phones. Therefore, it included all workers, undergraduates and health professionals of both sexes, over 18 years of age, working in the afternoon shift of the sectors of the intermediate care unit (IMCU), Neonatal Intensive Care Unit (NICU) and Adult (ICU), Hospital Infection Control Commission (CCIH), Adult Inpatient Unit and Pharmacy, who agreed to participate in the study and signed the Informed Consent Form.

The project was approved by the ethic committee of the University of Santa Cruz do Sul (UNISC) under protocol 3.518.375 (CAAE:18448719.7.0000.5343).

SOCIODEMOGRAPHIC DATA

In the first stage, the participants completed a sociodemographic questionnaire containing information about age, sex, position, education and work, as well as about the routine of using the cell phone during the workday (frequency of use and asepsis) and other asepsis techniques and awareness of the importance of mobile phone hygiene.

MICROBIOLOGICAL DATA

In the second stage, samples were collected from cell phone surfaces, using swabs soaked in sterile saline and packed in Brain Heart Infusion broth (BHI, Merck®, Darmstadt, Germany). The samples were transported to the microbiology laboratory at the University of Santa Cruz do Sul and incubated at $36^{\circ}\text{C} \pm 1^{\circ}\text{C}$ for 24 hours. Afterwards, with the aid of a 0.01 mL calibrated loop, the samples were sown in Petri dishes containing nutrient medium (Merck®, Darmstadt, Germany) and were again incubated at $36 \pm 1^{\circ}\text{C}$ for 24 hours. Subsequently, the number of colony-forming units (CFUs / mL) was counted, with the aid of an automatic colony counter. To identify the bacteria, the Gram staining technique was initially performed, followed by catalase, coagulase, DNase, NaCl 6.5% and Bile esculin tests for Gram positive bacteria, and biochemical tests, such as triple sugar iron agar (TSI), use of lysine (LIA) and urea, production of H₂S and indole, motility, use of citrate, for Gram negative bacteria, according to the handbook of the National Health Surveillance Agency¹⁶.

STATISTICAL ANALYSIS

The descriptive analysis was presented in frequency, mean and standard deviation. Associations between categorical variables were assessed using the total frequency and the Chi Square test, considering the results with $p \leq 0.05$ statistically significant. The

data were tabulated and analyzed using SPSS version 23.0 (SPSS Inc., Armonk, NY, USA).

RESULTS

After applying the inclusion criteria, the study remained with 50 participants, whose average age was 30.8 ± 8.25 years, in which 82% were female. It was observed that there was a greater participation of resident professionals (22%) of the Multiprofessional and Medical Residency Program and those who were working in the adult hospitalization sector (32%) (Table 1).

Table 2 shows the characteristics of cell phone use. It can be seen that 84% use it in apron pockets, 52% sanitize it with alcohol and paper towels and 36% sanitize the cell phone two or more times a week and 100% are aware that cell phones are one of the main vectors of transmission of HAIs.

Among 50 cultures of cell phones of workers, students and health professionals, 34 (68%) had bacterial growth. The most frequently isolated bacteria were, respectively, *Staphylococci* coagulase negative - CoNS (47.0%), *Staphylococcus aureus* (20.6%) and *Streptococcus* spp. (17.6%).

Regarding the professions/occupations of the research participants with the number of isolates (Table 3), it was possible to verify that the cell phones of residents (18.0%) and undergraduates (14%) were the ones that presented, most frequently, bacterial growth. As for those exempt from growth, there was a predominance in the cell phones of doctors and pharmacy assistants.

Table 1. Relation between the sociodemographic data of the research participants and the use of cell phones during the workday

		Use of cell phone		<i>p</i> ***
		Yes	No	
		N (%)	N (%)	
Sex	Male	9 (18,0)	-	0,499
	Female	39 (78,0)	2 (4,0)	
Education	Complete high school	4 (8,0)	2 (4,0)	<0,001
	Incomplete higher education	7 (14,0)	-	
	Complete higher education	37 (74,0%)	-	
Position	Nuse	5 (10,0)	-	0,054
	Nurse technician	1 (2,0)	1 (2,0)	
	Resident*	11 (22,0)	-	
	Doctor	8 (16,0)	-	
	Pharmacist	1 (2,0)	-	
	Physiotherapist	5 (10,0)	-	
	Undergraduate**	9 (18,0)	-	
	Pharmacy assistant	8 (16,0)	1 (2,0)	
Sector	IMCU	6 (12,0)	-	0,218
	NICU	4 (8,0)	-	
	CCIH	3 (6,0)	1 (2,0)	
	Adult ICU	10 (20,0)	-	
	Adult inpatient unit	16 (32,0)	-	
	Pharmacy	9 (18,0)	1 (2,0)	

*Professionals of the Multiprofessional and Medical Residency Program. **Undergraduates of Pharmacy, Physiotherapy and Medicine degrees doing internship at the institution. *** Pearson's Chi-square test. IMCU (Intermediate Care Unit). ICU (Intensive Care Unit). CCIH (Hospital Infection Control Commission).

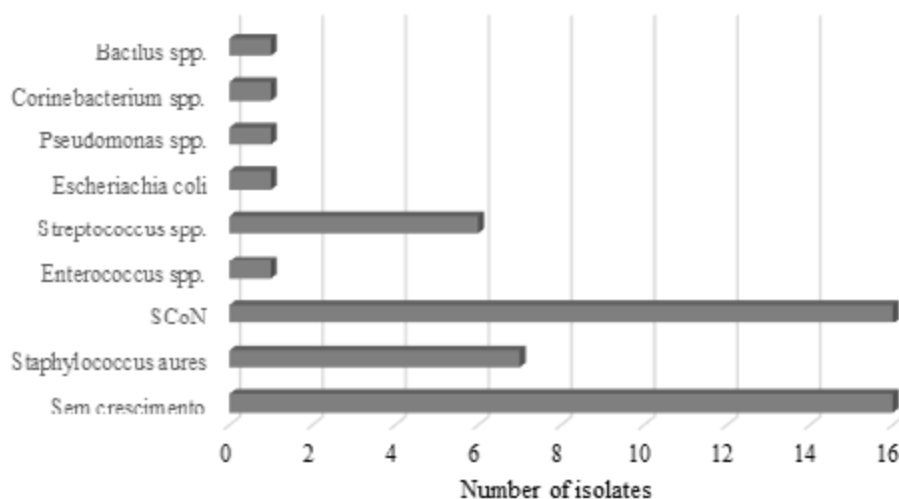
**Figure 1.** Isolated bacteria of research participants' cell phones.

Table 2. Characteristics regarding cell phone use and care by study participants

		Use of cell phone		p*
		Yes N (%)	No N (%)	
Place where you keep the cell phone	Pocket	42 (84,0)	-	<0,001
	Table	6 (12,0)	1 (2,0)	
	Bag	-	1 (2,0)	
How you sanitize it	Alcohol and paper towel	25 (50,0)	1 (2,0)	0,467
	Damp cloth	9 (18,0)	1 (2,0)	
	None	14 (28,0)	-	
Mobile phone cleaning frequency	2 or more times/week	18 (36,0)	-	0,007
	once/week	7 (14,0)	1 (2,0)	
	once/month	8 (16,0)	-	
	Never	14 (28,0)	-	
	Every day	1 (2,0)	1 (2,0)	
Awareness of the importance of asepsis	Yes	48 (96,0)	2 (4,0)	-
	No	-	-	

* Pearson's Chi-square test

Table 3. Comparison between professions and isolated microorganisms

	Nurse N (%)	Nurse Tech. N (%)	Resident* N (%)	Doctor N (%)	Pharmacist N (%)	Physiotherapist N (%)	Undergraduate** N (%)	Pharmacy assist. N (%)	p*
Microorganism									
<i>Bacillus</i> spp.	-	-	-	-	1 (2,0)	-	-	-	0,004
<i>Corynebacterium</i> spp.	-	-	-	1 (2,0)	-	-	-	-	
<i>Pseudomonas</i> spp.	-	-	-	-	-	-	1 (2,0)	-	
<i>E. coli</i>	-	-	1 (2,0)	-	-	-	-	-	
<i>Streptococcus</i> spp.	-	1 (2,0)	1 (2,0)	-	-	1 (2,0)	2 (4,0)	1 (2,0)	
<i>Enterococcus</i> spp.	-	-	-	-	-	-	-	1 (2,0)	
CoNS	-	1 (2,0)	5 (10,0)	3 (6,0)	-	1 (2,0)	3 (6,0)	3 (6,0)	
<i>S. aureus</i>	2 (4,0)	-	-	-	-	2 (4,0)	1 (2,0)	-	
No growth	3 (6,0)	-	2 (4,0)	4 (8,0)	-	1 (2,0)	2 (4,0)	4 (8,0)	
Microbial count									
More than 100 CFU/ mL	2 (4,0)	2 (4,0)	9 (18,0)	4 (8,0)	1 (2,0)	4 (8,0)	7 (14,0)	5 (10,0)	0,457
No growth	3 (6,0)	-	2 (4,0)	4 (8,0)	-	1 (2,0)	2 (4,0)	4 (8,0)	

* Professionals of the Multiprofessional and Medical Residency Program. ** Undergraduates of Pharmacy, Physiotherapy and Medicine degrees doing internship at the institution. *** Pearson's Chi-square test. CFU (Colony-forming unit); Nurse Tech. (Nurse Technician); Pharmacy assist. (Pharmacy assistant). CoNS (Coagulase-negative *Staphylococci*).

DISCUSSION

The mobile phone is widely used during the workday and, due to the advancement of technology, the use of these devices in clinical settings has been considered a very promising tool to support health care^{7,9,17}. Knowing the risks of cross-contamination through hospital instruments and inanimate surfaces, HAIs have been generating increasing concern for health institutions^{2-4,18}. With the help of this study it was possible to verify that 96% of the interviewees used the cell phone while working, and in 68% there was bacterial growth, and CoNS was the most prevalent; results that corroborate with other studies^{5,10,13}.

Even in health institutions, cell phones have a high frequency of use and are generally in direct contact with parts of the body, such as hands and face. Once in operation, these devices can heat up and reach temperatures that favor survival and even microbial growth⁶. Thus, cell phones can act as a reservoir of microorganisms and be associated with HAIs, and they can be transmitted to the operational environment by the health team or, even, infect immunosuppressed patients^{3,19}.

The rate of contaminated cell phones identified in this study was similar to that found in a hospital in Northern Ireland, in which there was growth of microorganisms in 60% of the tested mobile phones⁷. A similar profile was also found on cell phones of doctors and medical students, in a hospital in Australia, where there was growth in 74% of mobile telephone devices⁵. Higher isolation rates were found in a University Hospital in eastern Ethiopia, whose bacterial growth was 94.2% of health professionals' cell phones¹². It is noteworthy that this variation may occur due to adherence to infection prevention and the frequency of sanitation of cell phones during the workday¹².

Among mobile devices with bacterial growth, 67.6% were contaminated by Staphylococci-positive Gram bacteria, 47.0% of the isolates were CoNS and 20.6% *S. aureus*, similarly to other studies^{5,11,12,14}. It

is known that CoNSs have relatively low virulence and are bacteria of the skin microbiota, however, it is increasingly related to nosocomial bacteremia associated with invasive medical devices²⁰⁻²². It is worth mentioning that, in a study carried out in the same hospital in which the cell samples were collected, the bacteria most related to HAI cases were CoNS (30%), followed by *S. aureus* (13.3%), showing that the patient's microbiota can interact with the environment and with their own immune status, creating a risk for the development of infections^{22,23}.

It was also possible to observe that the cell phones of residents and undergraduates were the ones that contained bacterial contamination the most. According to a study conducted in an Australian hospital, medical residents were considered to be a risk factor for large bacterial growth on their cell phones⁵. In a hospital in India, the greatest contamination occurred on the phones of doctors and hospital staff, followed by medicine students¹¹.

Our results demonstrate that, although all interviewees are aware of the importance of asepsis of the cell phone, only 72% perform some type of cleaning, whose frequency varies. There is still no guideline, be it national or international, which aims to provide guidance on preventive strategies to reduce the risk of cross-contamination in health environments related to the use of cell phones^{6,17,24}. In light of this, improving and enabling asepsis practices is an ongoing challenge, whether for hand hygiene, disinfecting the mobile phone or continuing education for health professionals^{1,6}.

The strengths of this study were to reinforce the importance of advising professionals on how to clean the cell phone, which should be performed in conjunction with hand asepsis, in order to reduce the chances of their cell phones to serve as fomites for microbial dissemination. The weaknesses of this study, on the other hand, include collection in just one moment and possible biases in filling out the questionnaire.

FINAL CONSIDERATIONS

Given the above, it is concluded that 48 interviewees used the cell phone during their working hours, which may be related to the number of cell phones in which there was bacterial growth. What is more, the ways of cleaning it, in most cases, were performed with alcohol and paper towels and two or more times a week. Among cell phones samples, there was a predominance of the *Staphylococcus* genus, in which CoNS was the most frequently isolated bacterium.

The importance of further studies on microbial isolation in professional cell phones, in all sectors of the hospital, before and after asepsis, as well as the testing of the bacterial susceptibility profile of the isolates, is emphasized. It is important to develop internal rules for the hygiene of cell phones for health institutions with the help of future studies.

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