



BACTERIAL ETIOLOGY IN CELL PHONES OF HEALTHCARE PERSONNEL FROM A CLINIC IN CHICLAYO

ETIOLOGÍA BACTERIANA EN TELÉFONOS CELULARES DEL PERSONAL DE SALUD DE UNA CLÍNICA DE CHICLAYO

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ABSTRACT

The study aimed to describe the etiology and bacterial frequency on the cell phones of healthcare personnel at the Hospital de Clínicas de Chiclayo, Peru, from March to August 2022. Thirty phones from doctors, nurses, and technicians in hospitalization areas and the Intensive Vigilance Unit (IVU) were analyzed. Samples were taken from the phone screens, cultured, and bacteria were identified using biochemical tests. The data was recorded and analyzed with Microsoft Excel 2013. Bacterial colonization was found on 56.7% of the phones: Gram-positive bacteria on 33.3% and Gram-negative bacteria on 23.3%. Staphylococcus coagulase-negative (35.3%) and Escherichia coli (23.5%) predominated in hospitalization, while Staphylococcus aureus (23.5%) predominated in the IVU. 66.7% of the personnel rarely disinfected their phones, and 40% washed their hands infrequently. Staphylococcus coagulase-negative, S. aureus, and E. coli were the most frequent agents, suggesting deficiencies in hospital hygiene practices.

Keywords: Smartphone; Health Personnel; Hospitals, Private. (Source: MESH-NLM)

RESUMEN

El estudio buscó describir la etiología y frecuencia bacteriana en los teléfonos celulares del personal de salud en el Hospital de Clínicas de Chiclayo, Perú, de marzo a agosto de 2022. Se analizaron 30 teléfonos de médicos, enfermeros y técnicos en áreas de hospitalización y Unidad de Vigilancia Intensiva (UVI). Se tomaron muestras de las pantallas, se cultivaron y se identificaron las bacterias mediante pruebas bioquímicas. Se registró y analizó la información con Microsoft Excel 2013. El 56,7 % de los teléfonos presentó colonización bacteriana: Gram positivas en 33,3 % y Gram negativas en 23,3 %. Predominaron Staphylococcus coagulasa negativa (35,3 %) y Escherichia coli (23,5 %) en hospitalización, y Staphylococcus aureus (23,5 %) en UVI. El 66,7 % desinfectaba los teléfonos poco y el 40 % lavaba las manos con poca frecuencia. Staphylococcus coagulasa negativa, S. aureus y E. coli fueron los agentes más frecuentes, sugiriendo deficiencias en la higiene hospitalaria

Palabras clave: Teléfono Inteligente; Personal de Salud; Hospitales Privados. (Fuente: DeCS- BIREME)

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INTRODUCTION

Currently, communication through cell phones has become a necessity in our lives, with 94.9% of Peruvian households having at least one member with such a device, and 89.3% of the population aged six and older accessing the internet through their cell phones⁽¹⁾. These devices are also used in work activities by students and healthcare personnel, who, when interacting with human skin, bags, the environment, and food, contaminate them with pathogenic microorganisms⁽²⁾. This constitutes a significant risk, as cell phones act as reservoirs and fomites for the transmission⁽³⁾ of bacteria, fungi, viruses, and resistance genes⁽⁴⁾.

The use of cell phones in hospital environments is a common practice among healthcare personnel, representing a potential source of transmission for *Staphylococcus aureus* (85.7%) and *Escherichia coli* (61.9%)⁽⁵⁾. There have also been reports of coagulase-negative *Staphylococcus* sp. (SCON)⁽⁶⁾, *Enterobacter aerogenes*, and *Klebsiella* species isolated from cell phones of nursing and medical students⁽⁷⁾. This situation is due to the fact that the hands of healthcare workers and their phones are often (2-4) contaminated with one or more types of microorganisms, both sensitive and resistant, due to the lack of disinfection among healthcare professionals. Therefore, the objective of this study was to describe the etiology and frequency of bacterial contamination on the cell phones of healthcare personnel at a clinic in Chiclayo.

METHODS

The study was observational, descriptive, and cross-sectional. It was conducted at the Hospital de Clínicas, located in Chiclayo, a city in the northern region of Peru. This hospital is a private, high-complexity healthcare facility with capacity for care in various specialties.

Information was obtained from healthcare personnel working in hospitalization areas and the Intensive Care Unit (ICU) during the period from March to August 2022. A non-probabilistic sampling of 30 cell phones (Huawei Y9, Huawei P30Lite, Huawei Y7P, Redmi Note 9, Xiaomi 11Lite, Oppo A38, iPhone, Samsung S10 and Samsung Galaxy: Note 8, S10, A04, A12, A15, A25, A30s, A32)

voluntarily provided by healthcare personnel (comprising doctors, nurses, and technicians) was performed. Only subjects who performed care duties and had direct contact with patients were selected; those performing administrative functions were excluded.

Data collection began with the completion of informed consent and the survey by healthcare personnel in the hospitalization and ICU areas, who voluntarily agreed to participate. Subsequently, sample collection was carried out.

The sample collection procedure followed the method of Alvarado, Muñoz, and Zavaleta (2018) (Ezpeleta et al.⁽⁸⁾). In the hospitalization and ICU areas, a work area was disinfected with 70% alcohol. The owners were asked to place their cell phones in a Ziploc bag with a code. During sample collection, two alcohol burners separated by 20 cm were used to maintain a sterile space. The touch screens of the phones were swabbed over an area of 5 cm², wetting the sterile swab in BHI medium. The swab head was placed in a test tube with BHI medium and transported to the laboratory in a thermal container to be incubated at 37 °C for 24 hours. After sample collection, the phones were cleaned with gauze moistened with 70% isopropyl alcohol and returned to their owners.

The samples in BHI medium were incubated at 37 °C for 24 hours. Turbidity in the tubes indicated bacterial growth. They were then re-streaked on Blood Agar, MacConkey Agar, Mannitol Salt Agar, and Cetrimide Agar plates, incubated at 37 °C for 24 hours. The recommendations of the Manual of Bacteriological Procedures in Nosocomial Infections and the interpretations of biochemical reactions were followed according to the guidelines of Farmer et al⁽⁹⁾.

For identification, Gram staining of incubated colonies was performed to observe bacterial morphology. They were then transferred to a cryovial with appropriate culture medium, incubated at 37 °C for 24 hours. Biochemical tests were then performed for bacterial identification.

For Gram-positive bacteria, the catalase test was used: a sample of the pure culture was placed on a slide with 10% hydrogen peroxide. Bubbles observed within 10-20 seconds indicated a positive test. In the coagulase test, a blood sample was centrifuged at 4,000 rpm for five minutes to obtain citrated plasma. 500 µL of plasma was placed in a sterile tube with a sample of the pure culture and incubated at 37 °C, with clot formation observed every 30 minutes for four hours.

For Gram-negative bacteria, the oxidase test was performed: a sample of the pure culture was placed on a strip of paper with oxidase reagent for 10-60 seconds. A violet color indicated a positive reaction. Fermentation tests were conducted using media such as Simmons Citrate, Lysine Iron Agar (LIA), Motility Indole Ornithine (MIO), and Triple Sugar Iron Agar (TSI). Pure culture was inoculated by stabbing or streaking and incubated at 37 °C for 24 hours for subsequent reading.

The information obtained from the surveys and cultures was recorded in a Microsoft Excel 2013 electronic template. Quality controls were performed using filters and variable verification. Data were expressed in tables with absolute and relative frequencies. Authorization was requested from the director of Hospital de Clínicas Lambayeque SAC for project execution in the laboratory area. Healthcare personnel were also interviewed to fill out informed consent forms, allowing the use of their cell phones in the research.

RESULTS

Of the healthcare personnel evaluated, 60% were female and 40% male. Nursing personnel predominated, representing 46.7% of the total. Of the cell phones analyzed, 56.7% showed bacterial colonization, with the presence of Gram-positive and Gram-negative bacteria in 33.3% and 23.3% of the devices, respectively (Table 1).

Table 1. Characteristics of healthcare personnel and cell phone devices evaluated at the Hospital de Clínicas from March to August 2022.

Characteristics	Frequency	Percentage (%)
Sex		
Male	12	40
Female	18	60
Healthcare personnel		
Doctors	7	23,3
Nurses	14	46,7
Nursing technicians	9	30
Work areas		
ICU	11	36,7
Hospitalization	19	63,3
Cell phone colonization		
Not contaminated	13	43,3
Contaminated	17	56,7
Isolated microorganism		
Gram-positive	10	33,3
Gram-negative	7	23,3
None	13	43,3



The predominant microorganisms in the 17 contaminated cell phones were *SCON* and *E. coli* with 35.3% and 23.5%, respectively, which originated from the devices of personnel working in the hospitalization

area. *Staphylococcus aureus* was isolated only in the ICU area (23.5%), while *Pseudomonas aeruginosa* was isolated in both the hospitalization and ICU areas (Table 2).

Table 2. Bacterial etiology by work area at the Hospital de Clínicas from March to August 2022.

Microorganisms	ICU		Hospitalization	
	n	%	n	%
Coagulase-negative <i>Staphylococcus</i> sp.	0	0.0%	6	35.3%
<i>Staphylococcus aureus</i>	4	23.5%	0	0.0%
<i>Escherichia coli</i>	1	5.9%	4	23.5%
<i>Pseudomonas aeruginosa</i>	1	5.9%	1	5.9%

UCI: Intensive Care Unit

The survey on the habits of healthcare personnel and cell phone use reveals that before work, 43% (13) use it frequently and 56.7% (17) very frequently. During work, 46.7% (14) use it infrequently and 53.3% (16) frequently. In restrooms, 26.7% (8) use the phone infrequently

and 73.3% (22) never use it. For disinfection, 66.7% (20) do it infrequently and 33.3% (10) frequently. Regarding hand washing, 40% (12) do it infrequently and 60% (18) frequently (Table 3).

Table 3. Habits and frequency of cell phone use by healthcare personnel at the Hospital de Clínicas from March to August 2022.

Work habits	FREQUENCY			
	Never n (%)	Occasionally n (%)	Regularly n (%)	Habitually n (%)
Use of cell phone before work	0 (0)	0 (0)	13 (43.3)	17 (56.7)
Use of cell phone during work	0 (0)	14 (46.7)	16 (53.3)	0 (0)
Use of cell phone in restrooms	22(73.3)	8 (26.7)	0 (0)	0 (0)
Frequency of disinfection	0 (0)	20 (66.7)	10 (33.3)	0 (0)
Frequency of hand washing	0 (0)	12(40.0)	18 (60.0)	0 (0)

DISCUSSION

The results confirm the presence of pathogenic Gram-positive and Gram-negative bacteria on the cell phones evaluated. Similar findings have been reported in students from a public university⁽⁶⁾, where different environmental surfaces can serve as potential reservoirs for nosocomial pathogens and facilitate their transmission by contact, depending on their tenacity. Many microorganisms can survive on inanimate surfaces for days, weeks, and even months, increasing

the likelihood of transmission within a healthcare facility⁽¹⁰⁾. Bacterial contamination on the evaluated phones was 56.7%. These results differ from the 100% colonization in 40 cell phones analyzed in a university hospital in Egypt and the 84.8% in 50 phones of healthcare personnel in Huancayo, Peru⁽¹¹⁾. In hospitals in Spain, contamination was 49.5%, demonstrating that these devices are used without restrictions for disinfection and, therefore, constitute a source of transmission of pathogenic bacteria with the risk of

causing nosocomial infections⁽¹²⁾. The most frequent isolates in the study were SCON and *Escherichia coli*, with 35.3% and 23.5%, respectively. Similar reports indicate a prevalence of 40% and 28.7% in Huancayo⁽¹¹⁾ and 37.5% of SCON, and 24.4% of Enterobacteriaceae in Trujillo⁽¹³⁾. In Lima, 93.5% of SCON, 6.5% of *Staphylococcus aureus*, and 11.1% of *E. coli* were isolated⁽⁶⁾. These findings are comparable to Santana-Padilla's study⁽¹²⁾, albeit with slight differences in isolation frequency, who obtained growth of *Pseudomonas aeruginosa* (12.5%) and methicillin-resistant *S. aureus* (10.9%). These data highlight that the use of cell phones, while offering communication and information access advantages, also presents the disadvantage of being a potential source for the spread of pathogenic bacteria in the hospital environment.

The predominance of SCON among the identified isolates is due to their normal presence as part of the skin microbiota. When hands interact with the cell phone, an opportune microenvironment is created for their proliferation⁽¹⁴⁾. Bacteria survive and persist on various inanimate surfaces such as metal, fabric, plastic, wood, and ceramic⁽¹⁵⁾, as well as on medical devices, cell phones, and computers in critical units⁽¹⁶⁾. This capability is due to cell wall-anchored proteins of *Staphylococcus* that allow adherence to inert material⁽¹⁴⁾, or in the case of *P. aeruginosa*, forming biofilms with alginate, PSL, and PEL exopolysaccharides⁽¹⁷⁾.

Therefore, the hospital environment is highly contaminated by pathogenic microorganisms, related to their survival time and the cleaning and disinfection processes⁽¹⁸⁾. The evaluation highlighted the use of cell

phones before and during work activities with infrequent disinfection by healthcare personnel. Similar results occurred in healthcare workers in two hospitals in Brazil, who claim to be sufficiently trained but do not follow standard practices⁽¹⁹⁾. This attitude also occurs in students interacting with patients. This reality highlights the non-compliance with standard precautions aimed at protecting and ensuring safe care. Good hand hygiene practices, asepsis, and the use of personal protective equipment prevent nosocomial infections⁽²⁰⁾. Therefore, compliance with these safety measures requires special attention due to the risk posed by the presence of infectious pathogens for patients, visitors, and healthcare workers.

As a study limitation, it was not possible to carry out several measures that would have allowed evaluating the variation in cell phone contamination at different times. Additionally, antimicrobial susceptibility was not performed, so the resistance pattern and some resistance mechanisms are unknown. However, comparative studies of bacterial isolates from cell devices and the hands of healthcare personnel are recommended to establish associations and raise awareness among staff about the importance of complying with hygiene and biosafety practices.

In conclusion, SCON, *S. aureus*, and *E. coli* were the most frequently isolated etiological agents on cell phone surfaces of healthcare personnel working in the ICU and hospitalization areas of a hospital in Chiclayo. The high percentage of contamination by pathogenic and opportunistic bacteria could be due to non-compliance with good hygiene practices by healthcare personnel in the hospital environment.

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