

Frequency of gram-negative bacteria found in cellular phones of nursing students

Álvarez-Rangel, María Isabel¹; Flores-Patiño, Gerardo²; Lazarini-Torres Itzen³; Cazares-Patiño, Said Alejandro^{4*}; Silva-Camacho, Dolores Monserrat⁵; Moreno-Pérez, Norma Elvira⁶

ABSTRACT

Introduction: Nowadays, the indiscriminate use of cell phones has led to their use in inadequate conditions of hygiene.

Objective: Identify the frequency of gram-negative bacteria (*Salmonella typhimurium*, *Escherichia coli*, *Enterobacter aerogenes*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*) found in cell phones of students of the Bachelor's Degree in Nursing of a university in central Mexico. **Methodology:** The study used a quantitative and cross-sectional approach, and a descriptive scope. A non-probabilistic convenience sampling was carried out, selecting 60 students who previously gave their informed consent. Samples were taken from the cell phones, and incubation for 24 hours in tubes with Trypticasein Soy broth and streaking in Petri dishes took place, allowing incubation for 48 hours; after this process, the morphological characterization of the bacteria to determine their presence was carried out. **Results:** From 100% of the samples, 41.67% did not have bacterial growth and in 58.33% of the telephones the following results were obtained: *Salmonella typhi*, 2.98%; *Enterobacter aerogenes*, 28.35%; *Escherichia coli*, 28.35%; *Klebsiella*, 11.94%; *Pseudomonas*, 0.00%; and other, 28.35%. **Conclusion:** Most of the study sample showed in their cell phones potentially pathogenic bacteria, which resulted in a risk of cross-contamination, and a possible source of outbreaks of infections, both extrahospital and intrahospital.

Key words: Gram-negative bacteria; cellular phone; nursing students (DeCS).

¹ Student of the Bachelor's Degree in Nursing and Obstetrics. Universidad de Guanajuato. Mexico. Email: isabel.ar3@outlook.es ORCID:0000-0003-2154-9353

² Student of the Bachelor's Degree in Nursing and Obstetrics. Universidad de Guanajuato. Mexico. Email: poppergera@gmail.com ORCID:0000-0001-5697-8567

³ Student of the Bachelor's Degree in Nursing and Obstetrics. Universidad de Guanajuato. Mexico. Email: itzen_lt@outlook.com ORCID: 0000-0003-3868-5095

⁴ Student of the Bachelor's Degree in Nursing and Obstetrics. Universidad de Guanajuato. Mexico. Email: aletscazares@gmail.com ORCID:0000-0001-6027-1900

⁵ Student of the Bachelor's Degree in Nursing and Obstetrics. Universidad de Guanajuato. Mexico. Email: sc.monse96@gmail.com ORCID:0000-0002-0483-4374

⁶ Full-time Professor. Department of Clinical Nursing. Universidad de Guanajuato. Email: normaelvira.moreno2@gmail.com ORCID: 0000-0003-1829-3916.

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*Corresponding Author

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INTRODUCTION

Currently, most of people in almost the whole world use a cell phone to cover their needs of communication and other day-to-day activities, thus facilitating their everyday life. The problem arises when by habit the device is used in any place and time without reflection on its hygiene conditions, including health professionals, who at this time, consider the cell phone as one of their work tools, with the risk that such device becomes a transmitter of microorganisms due to the lack of hygiene measures appropriate to the context where cell phones are used⁽¹⁾.

If it is considered that cellular telephony has now reached health institutions, it should also be taken into account the risk that this implies, since as all objects that are in a hospital facility, the cell phone may be contaminated by the bacteria present in the environment or when entering into contact with biological fluids, then becoming a bacteria reservoir, subsequently spreading the bacteria inside and outside the facility if the proper hygiene measures are not taken⁽²⁾. In other words, the indiscriminate use of cell devices in unsanitary conditions can turn it in a fomite, which is defined as any inanimate object, either porous or not porous, which has the capacity to carry microorganisms such as bacteria, fungi, viruses, or parasites from one individual to another, thus forming part of a contamination chain⁽³⁾.

There is literature that describes the problem in different countries, showing the presence of potentially pathogenic bacteria in cell phones of students and workers of various disciplines in the health area, demonstrating the need to implement more comprehensive hygiene practices of the hands of the health professionals and of the devices they use⁽⁴⁾.

Some findings report the colonization of Gram-positive and Gram-negative bacteria⁽⁵⁻⁷⁾, such as the following, which are the most common: *Staphylococcus aureus*, *Streptococcus spp*, *Enterobacteriaceae*, *Pseudomona aeruginosa*, *Citrobacter*, *Escherichia coli*, and *Klebsiella pneumoniae*, noting that after disinfection with 70% isopropyl alcohol, in 60% of the devices considered in the sample total aerobic bacteria persisted, but without registration of contamination by *Escherichia coli*, which determined that 70% isopropyl alcohol is 40% effective for total aerobic bacteria, and 100% for *Escherichia coli*⁽⁸⁻¹⁰⁾.

In Mexico, according to a research carried out by the Section of Postgraduate Studies of the Higher School of Medicine of the National Polytechnic Institute in the emergency service of a regional general hospital of the Mexican Social Security Institute (IMSS), cultures from 71 cell phones were taken, of which 7 (9.85%) reported bacterial contamination of *Stafilococcus haemoliticum*, *Stafilococcus epidermidis*, *Stafilococcuss aprophyticus*, *Aerococcus viridians*, *Dermacoccus nishinomiyaensid*, *Bordetella bronchiseptica*, and *Stafilococcus kloosii*⁽²⁾.

Also in Mexico, in a study carried out by the Chemical Sciences Faculty of Gomez Palacio, Durango, in a Family Medicine and Surgery Specialties of the Institute for Security and Social Services for State Workers (ISSSTE) in Torreon Coahuila, samples were taken from a total of 51 cell phones, where bacterial strains in 12 cell phones were isolated, representing 23.5% of the total sample, emphasizing the isolation of two bacterial genres of clinical importance, namely, *Pseudomonas* and *Streptococcus* of the viridans group⁽¹¹⁾.

Therefore, the purpose of this study was the identification of the frequency of Gram-negative bacteria (*Salmonella typhimurium*, *Escherichia coli*, *Enterobacter aerogenes*, *Klebsiella pneumoniae*, and *Pseudomona aeruginosa*) found in cell phones of the students of the Bachelor's Degree in Nursing of one university in central Mexico.

METHODOLOGY

The study that was carried out corresponds to one applied research, with quantitative approach, descriptive scope, and non-experimental cross-sectional design. The population is comprised by the students of the eight semester of the Bachelor's Degree in Nursing, enrolled during the January-June 2019 school period of one public university in central Mexico. A non-probabilistic convenience sampling was carried out selecting 60 students, who were invited to participate on a voluntary basis, receiving their informed consent, and complying with the provisions set forth in articles 13, 14, 16, 17, 20, 21⁽¹³⁾ of the Title II, Chapter 1, of the General Health Bill.

Each participant received a socio-demographic data sheet including age, gender, health institution, and service where

Table 1. Age of the participants

Age (years)	f	%
18-20	0	0
21-23	57	95
24-26	3	5
27 o más	0	0

Source: Socio-demographic Data Sheet, 2019.

n= 60

f= Frequency, %= Percentage

Table 2. Gender of the participants

Gender	f	%
Male	9	15
Female	51	85

Source: Socio-demographic Data Sheet, 2019.

n= 60

f= Frequency, %= Percentage

the participant is carrying out his practical training at the time the sample was taken. A statistical analysis with frequency and percentage distribution was performed using Excel office 365 (2019 pro). Swab sampling was used to collect the samples on the surface of the cell phones, pre-moistened with liquid Trypticasein Soy broth (TSB). Sample taking in each telephone was performed passing the swab in zigzag on the screen area, buttons, and the back part, subsequently introducing the swab in the culture medium, cutting off the opposite part of the swab that was in contact with the hands in order to prevent contamination. Once the sample is taken, the cell phone was cleaned with 70% alcohol. Samples were incubated for 24 hours between 30°-35°C⁽¹⁴⁾.

The sample was taken directly from the tube with the TSB medium with an inoculation loop and the streaking in Petri dishes took place with the selected mediums (Salmonella-Shigella agar and violet red bile agar), 60 boxes of each medium. To inoculate the samples, an inoculation loop was taken which was previously sterilized using a burner, and through streaking in each Petri dish, respectively. Petri dishes were incubated 48 hours at a temperature of 30-35°C⁽¹⁴⁾. A description of the microbiological colonies that showed morphological characteristics visually different was carried out. Size, color, form, surface, and edge of the colony were the characteristics described, and the identification was performed using a table with the characteristic morphology of the colonies, according to the medium used⁽¹⁵⁾.

RESULTS

The total number of participants in the sample was 60, of which, the predominant age varied between 21 and 23 years (Table 1). Female was the predominant gender in the sample (85%) (Table 2).

The receiving institution where the study subjects performed their practice with more frequency was a health care facility located in the municipality of San Miguel de Allende with 38.33%; followed by the health district with 13.33% (Table 3). The most frequent service was the nursing office in secondary care facilities (26.66%), followed by the nursing office in the primary care level (21.66%), and the labor and delivery service (20%) (Table 4). This is because the objectives of the nursing practice that was carried out when the collection of samples took place consisted in delivery care and the administration process of the nursing services.

From the 60 samples that were taken, 25 (41.67%) did not have bacterial growth, while in the remaining 35 (58.33%), both *Enterobacter aerogenes* and *Escherichia coli* were identified along with other type of bacteria that did not corresponded to those set forth in the research (Table 5).

DISCUSSION

There are multiple germs that can be hosted in various sites inside health institutions. In this work it was observed that a considerable percentage of pathogenic bacteria are present in the cell phones that were sampled, namely, *Enterobacter aerogenes* and *Escherichia coli*, which is in line with the findings reported by Paz-Montes et al⁽⁴⁾, which report that 83% of the cell phones analyzed were positive for the presence of bacteria⁽¹⁾.

It is worth reflecting on the most common consequences of the *Enterobacter aerogenes* bacteria on human beings, which include a vast range of hospital infections such as pneumonia, urinary infections, wounds, and devices

Table 3. Receiving institutions for nursing practice of the participants

Institution	f	%
San Miguel Allende Health Facility	23	38.33
Celaya Health Facility	4	6.66
Maternity and Child Facility	5	8.33
IMSS	5	8.33
ISSSTE	5	8.33
CAISES	6	10
UMAPS	1	1.66
Health District	8	13.33
Community Hospital	3	5

Source: Socio-demographic Data Sheet, 2019.

n= 60

f= Frequency, %= Percentage

Table 4. Nursing practice services of the participants

Service	f	%
Labor and Delivery	12	20
Emergency	5	8.33
Obstetrics and Gynecology	7	11.66
Nursing Chief Office	16	26.66
Labor and Delivery Chief Office	1	1.66
Surgery Chief Office	1	1.66
ICU Chief Office	1	1.66
Obstetrics and Gynecology Chief Office	0	0
Emergency Chief Office	3	5
Internal Medicine Chief Office	1	1.66
Primary Care Chief Office	13	21.66

Source: Socio-demographic Data Sheet, 2019.

n= 60

f= Frequency, %= Percentage

Table 5. Frequency of bacteria found in the surface of the cell phones

Bacteria	f	%
Salmonella Typhi	2	2.98
Enterobacter Aerogenes	19	28.35
Pseudomona aeruginosa	0	0.0
Klebsiella	8	11.94
Escherichia Coli	19	28.35
Otras	19	28.35

Source: Own development. 2019.

f= Frequency, %= Percentage

infections. It is a microorganism with a clear contaminant action that especially affects premature children, and in general, to infants younger than 6 months old who receive formula milk ⁽¹⁶⁾.

While diarrhea is the most common consequence of *Escherichia coli*, it also causes dehydration and even death in children under the age of five, this bacterium represents a potential danger for human beings since it abounds in the environment. Clinical infection caused by *E. Coli* produces cramps and diarrhea, sometimes bloody diarrhea. It also may cause fever and vomiting. Most of the patients recover in a period of 10 days; however, in some cases death may occur ⁽¹⁷⁾.

Results show that these bacteria, potentially pathogenic, represent an important source of infection for the same subjects who participated in this study, and for the environment in which they move, in this case, the intra-hospital and their educational institution. Students in the health area, as professionals undergoing training, shall be aware of the indiscriminate use of cell phones within the sector of health services, since, as well as this research,

different studies show that if proper hygiene measures are not taken, personal items such as the cell phones, become fomites, thus, expanding contamination to intra-hospital and extra-hospital spaces.

Null presence of *Pseudomona aeruginosa* can be explained according to a study that stated that this bacterium is usually not isolated in the surface of cell phones, probably due to the fact that in these devices the necessary conditions for its optimum growth are not met, such as the generation of biofilms which allow adherence on the surface and formation of microcolonies ⁽¹²⁾.

CONCLUSIONS

On the basis of the results obtained, it was concluded that Gram-negative bacteria present in cell phones of nursing students who participated in this study were *Salmonella typhi*, *Enterobacter aerogenes*, *Escherichia coli*, and *Klebsiella*, thus demonstrating that a large part of the population who use cell phones in hospital areas are carriers of bacteria, the majority of which are potentially pathogenic, which constitute

a potential risk of cross-contamination and a possible source of intra-hospital and extra-hospital outbreaks.

The contribution of this study consist in the possibility of guiding the design of prevention campaigns regarding cross-transmission of microorganisms, from the implementation of internal programs in institutions providing health services to prevent infections associated to health care, such as hand washing and the use of gloves and masks at the time of having contact with the patient. This shall involve the rational use of cell phones and their respective cleaning within the hospital environment, in order to prevent the spread of bacteria through this device, thus contributing to reduce the economic impact that nosocomial infections represent for hospitals.

Since the contamination mechanism of cell phones is varied, that is, it can be through direct contact with a patient, with contaminated material or contaminated hands, etc., an important factor of common risk to health personnel, as well as to patients and their relatives, is the little or non-existent cleanliness of the surface of such devices, which shall become a routine practice in order to reduce the potential risk to act as fomite. In order to provide the solution to the contamination problem, a study could be designed where the effectiveness of some antiseptic solutions, proper for the care of cell phones that do not damage their fabrication material is analyzed.

One of the limitations of this study was that due to the dates set for the collection of data, we only had the participation of students from the eight semester of the educational program; ideally, it would have been much better to have the participation of students from several semesters, in order that they would have been engaged in diverse clinical practices in several services.

CONFLICT OF INTEREST

The authors declare they do not have any conflict of interest.

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Self-supporting

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