Prevalence and risks of mobile phone microbial contamination among medical, dental, and health sciences students in the healthcare setting

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ABSTRACT

Introduction. Cellular phones are usually used in both the individual and professional life. They are used in healthcare centers without limits, irrespective of their unknown infectious load, and thus cellular phones can serve as a container of infection in hospitals.

Aim. The present study aimed to identify microbial pollution of medical faculty students' s cellular phones and identify the microbial species found on the exteriors of their phones in order to take the necessary precautions.

Methods. 74 students from the medical faculties of Sirte University whom training in Ibn sina Educational Hospital and Dental Educational Clinic participant in the present study. A cross sectional study was accomplished during May to July 2023. A questionnaire was presented to all participants to collect the data. The swab samples were taken from mobile phones of all participants. The samples were then directly transmitted to the microbiology laboratory of Ibn Sina Educational Hospital, for cultured to identify the microbial contamination. Each sample was cultured on two different culture media (Blood and MacConky agar) and it incubated at 37 °C for 24 hours. Isolates were recognized on base of standard microbiology methods using gram stain pigmentation, colony morphology, catalase test, coagulase test in additional novobiocin test, Optochin test and bacitracin test.

Main results. Our findings reported that the microbial growth on mobile phones are 45(60.8%). The major proportion of growth bacteria is Gram-positive 43 (96%). While 2(4%) of growth bacteria are

Gram-negative. We observed the greatest percentage of microbial species are *Staphylococcus epidermidis* 39(72%), then *Streptococcus viridans* 6(11%), fungi 5(9%), *Streptococcus agalactiae* 2(4%), *Escherichia coli*, 2(4%).

Conclusion. The current study indicated that cellular phones are one of the most important means to transmitting infection in the community and hospitals. However, with proper use of disinfectants and proper hand hygiene practices it can be reduced.

Key wards: Cross-contamination, Infection control, Doctor and patient safety, Mobile phone, Microbial contamination, Medical students, Dental students, Health Sciences students, Healthcare Setting.

Introduction

Cellular phones are a vital device for communication and are used in all aspects of life. Medical students and healthcare workers (HCWs) use phones to communicate quickly and easily within hospitals. Mobile phones can help to reduce the time it takes to communicate important messages, which can help to prevent medical errors. Moreover, the development of mobile communication has give rise to improvements in the management of many medical conditions (Soto, R. G *et al*., 2006). But, they are infrequently cleaned and are usually contacted through or next investigation of patients and dealing of samples wanting appropriate hand lotion. Therefore, cellular phones have become an external exporter of contagion, not just for patients in hospitals, but too for possible health risks for staffs and family members (Kilic, I. H *et al*., 2009).

The constant usage of the cellular phone by healthcare professional exposures it to an collection of microbes and creates it adequate transporter for microorganisms, specifically those related with the epidermis, causing in the extent of various microbes from the worker (Ekrakene et al.,2009). The phones that utilized by medical students can performance as transportation carriages for pathogenic and nonpathogenic organisms together (Zakia, S ., et al, 2016). Never the less a own cellular phone is an often touched instrument in hospitals, but it is not regularly included in routine cleaning schedules. It can be polluted by resistant nosocomial pathogens and healthcare staffs use it through patient investigation. Previous studies also validate occurrences of infective diseases are more in those individuals who utilize polluted cellular phones. Though most private things are retained in changing rooms, cellular phones habitually accompany the staff into the operating theatre, critical care unit and wards where calls are made or replied whereas interest patients (Selim and Abaza, 2015).

Hand sanitation is confirmed for avoidance of hospital acquired infections and it is easy to application in developing countries where properties are restricted. Yet, the probable extent of illnesses by polluted instruments or other articles that are not deemed in routine cleaning programs is often connived, and they are a possible exporter of microorganisms in the hospitals, Gowns, gloves, bedside stethoscopes, neck ties, bed barriers, sheets, phones, flat surfaces, door knobs, thermometers, nurse's clothing and own bags are polluted via pathogenic bacteria (Heyba *et al*.,

2015). The hands and gloves of healthcare staffs facilely gain the pathogens after touch with polluted hospital surfaces and apparatus, and then transmit these organisms to then contacted patients (Collins AS., 2008). Around 80,000 to 180,000 infections could be avoided annually (Gastmeier *et al.*,2010) , specially via sufficient hand cleanliness and increased intensity of cellular phones cleaning (Tannhäuser *et al.*,2022). The aim of the present study is to inspect the microbial pollution of cellular phones of medical collages students and to identify the microbial species found on the surfaces of their phones.

Materials and methods

Study population and Methodology:

74 students from the medical faculties of Sirte University (Human medicine , Dental medicine and Health sciences) who training in Ibn sina Educational Hospital and Dental Educational Clinic participant in the present study. This a cross sectional study was achieved during May to July 2023. A questionnaire was presented to all participants to collect the data (Appendix.1). So as to prohibit cross-contamination, the data collectors were utilized an alcohol-based sanitizer to disinfect their hands before wiping each cellular phone . The swab samples were taken from cellular phones of all participants by wiping the front, back and edges of their phones using a sterile cotton swab which soaked with sterile distil water. The samples were then directly transferred to the microbiology laboratory of IbnSina Educational Hospital, for cultured to identify the microbial contamination. Each sample was cultured on two different culture media (Blood and MacConky agar) and it incubated at 37 °C for 24 hours. Isolates were recognized on base of standard microbiology methods using gram stain pigmentation, colony morphology, catalase test, coagulase test in a additional novobiocin test and optochin test and bacitracin test.

Ethical consent: Oral agreement was secured from all participants and they filled the questionnaire of this study.

Statistical Analysis of Data: The qualitative data was presented as frequency and percentage.

Results

Distribution of the study sample according to gender

74 students from medical faculty of Sirte University participant in this study. We observe that the major proportion of the participants is female 52(70%), while male participants are 22 (30%) as shows (**Figure 1**) .
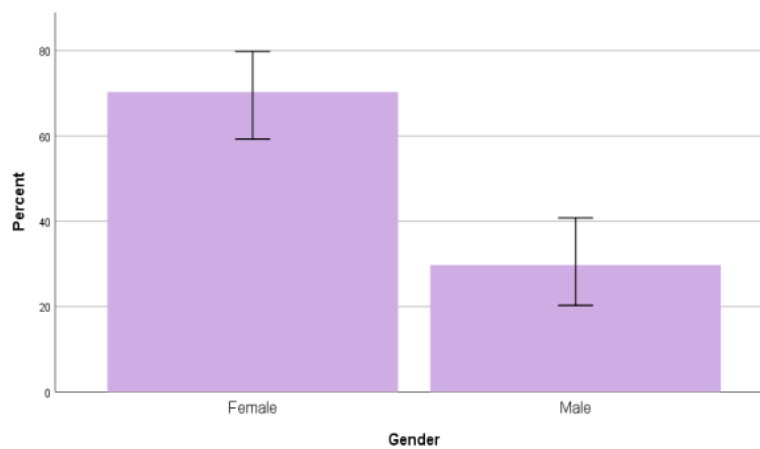

Figure 1: Distribution of the study sample according to gender .

Distribution of the study sample according to the Faculty

Figure 2 illustrated the participants according to Medical Faculty. 41 students (55.41%) are from the Faculty of Human Medicine, and 22 (29.73%), 11 (14.86%) students from the Faculty of Dentistry and Oral Surgery, Faculty of Health Sciences respectively.
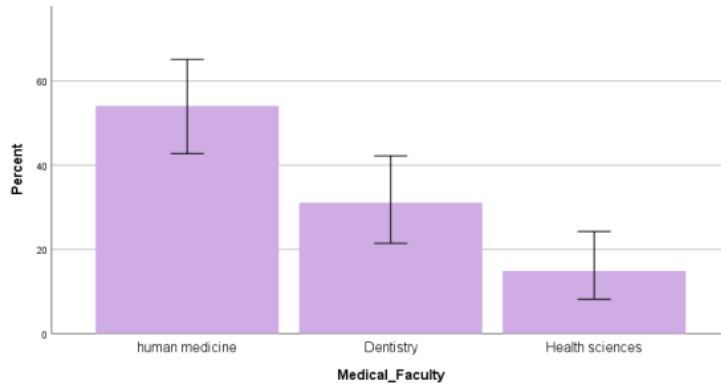
Figure 2: Distribution of the study sample according to the medical faculty

Distribution of the study sample according to microbial growth on cellular phones.

After culture the swabs, we observe the microbial growth are presence on 45 (60.8%) phones. Whereas, 29(39.2%) phones are not presence the microbial growth on them as shows **(Figure 3).**
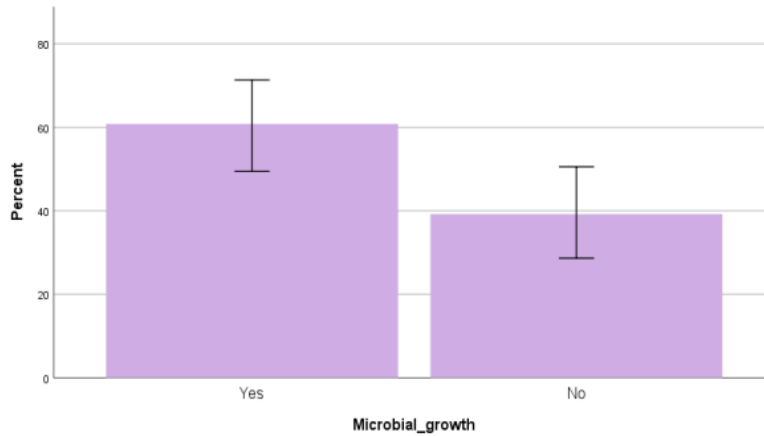

Figure 3: Distribution of the study sample according to microbial growth on cellular phones.

Distribution of the growth bacteria according to Gram stain

According to Gram stain, **figure 4** shows the major proportion of growth bacteria is Gram-positive 43 (96%). While 2(4%) of growth bacteria are Gram-negative.
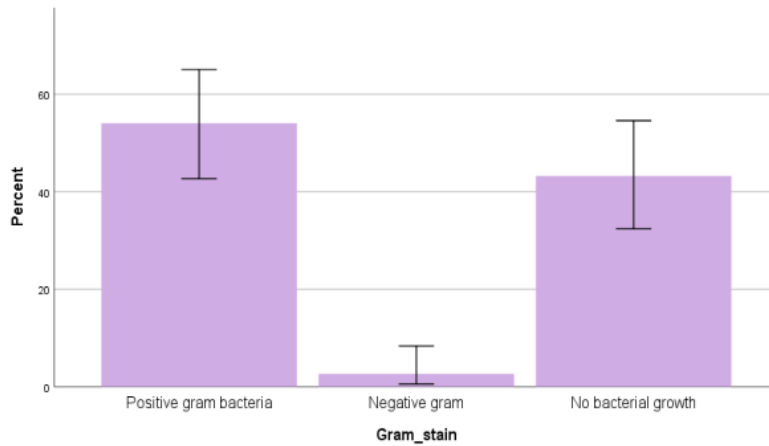
Figure 4: Distribution of the growth bacteria according to Gram stain

Distribution of the study sample according to microbial species

Figure 5 illustrates the microbial species that isolated from student's mobile phones whom training in health facilities. We observed the greatest percentage of microbial species are *Staphylococcus epidermidis* 39 (72%), then *Streptococcus viridans* 6 (11%), fungi 5 (9%), *Streptococcus agalactiae* 2 (4%), *Escherichia coli*, 2 (4%).
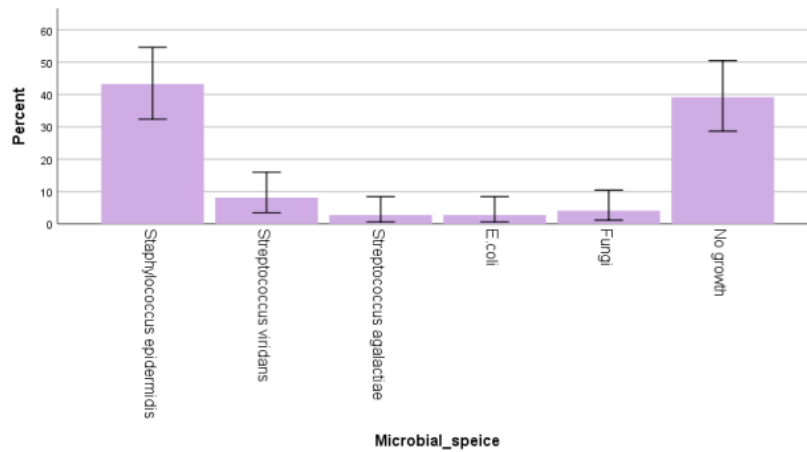

Figure 5: Distribution of the study sample according to microbial species

Distribution of microbial growth according to gender

According to the gender of students, we observe that the largest percentage of microbial growth is on female's phones 30 (67%), while the percentage of microbial growth on male's phone is 15 (33%) as shown as **(Figure 6).**
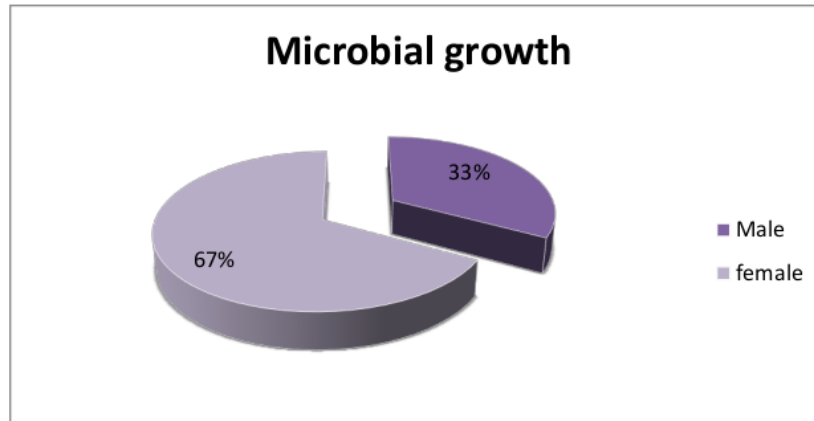
Figure 6: Distribution of microbial growth according to gender.

Distribution of microbial growth according to medical faculty.

Figure 7 illustrates that the highest percentage of presence the microbial growth on phones is among students of Human Medicine Faculty 27(60%). While, 13(29%), 5(11%) on phones of students from the Faculty of Dentistry and Oral Surgery, Faculty of Health Sciences respectively.

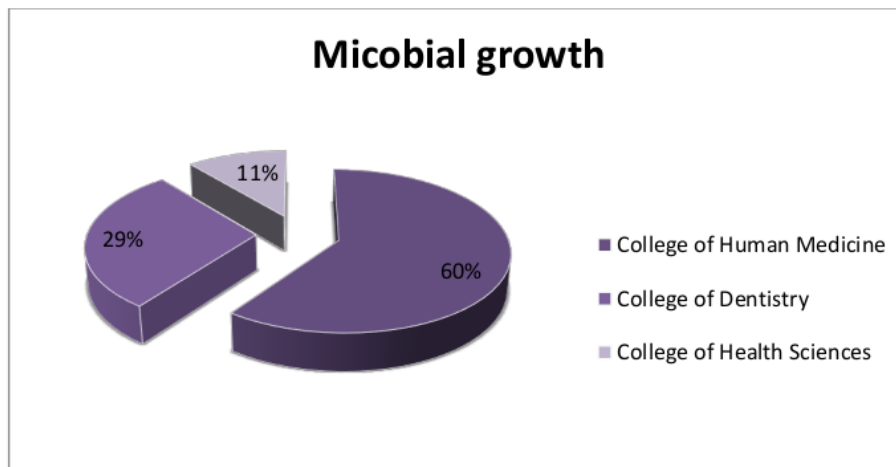

Figure 7: Distribution of microbial growth according to medical faculty.

Distribution of microbial growth according to department.

Table 1 shows the highest proportion of isolated microbial from cellular phones of medical students whom training in Gynecology department 11 (24.44%),then 10 (22.22%) in conservation treatment

department, 6 (13.33%) in Ophthalmology and Internal medicine departments, 3 (6.66%) in Medical laboratories department, 2 (4.44%) in X-ray, ICU, Diagnosis and Conservation treatment departments, 1 (2.22%) in Pediatric, Surgery and Medical examination departments.

Presence of microbial growth in Department	Frequency	Percentage
Medical lab	3	6.66%
X-ray	2	4.44%
Gynecology	11	24.44%
Ophthalmology	6	13.33%
Pediatric	1	2.22%
Internal medicine	6	13.33%
ICU	2	4.44%
Surgery	1	2.22%
Diagnosis	2	4.44%
Medical examination	1	2.22%
Conservation treatment	10	22.22%
Total	45	100%

Table. 1: Distribution of the presence of microbial growth according to department

Discussion

This study aimed to determine the bacterial contamination of cellular phones among students of the medical faculties whom training in healthcare settings Sirte city. The healthcare setting environment plays a critical role in the transmission of organisms associated with nosocomial infections. Microorganisms can be transmitted from one person to another or from inanimate objects (such as stethoscopes, bronchoscopes, pagers, ballpoint pens, hospital patient charts, computer keyboards, mobile phones, and landline telephone to the hands and vice versa (Goldblatt et al., 2007, Ferrer-Roca et al., 2004, Ali AA, 2018). In this study, we found that the prevalence of organisms on medical students' mobile phones was (60.8%) in contrast to another study in Nigeria, where high contamination rates (80.6%) were reported by Amala et al., 2015) and in study that conducted by Zakai et al., 2015 reported the percentage of bacterial contamination on the tested cell phones was 96.2%.

Cellular phones used by medical students in hospital departments that may be contaminated with bacterial pathogens. The results of this study suggest that cellular phones are carry the pathogenic bacteria, including Gram-positive and Gram-negative bacteria that can spread mononucleosis. The present study showed a high level of contamination with Gram-positive bacteria 43 (96%) and lower with Gram-negative bacteria 2 (4%).

In study conducted by Domenico et al.,2020, they reported that Staphylococci were present in 85% of cellular phones, Enterococci in 37%, Coliforms in 6.5%; E. coli was never detected. Staphylococcus epidermidis was the most frequently isolated staphylococcal species (72%). Our finding agree with this study in Staphylococcus epidermidis was the most frequently isolated staphylococcal species from our samples (70%), but the Escherichia coli was detected in the present

study (4%). Study published in Iraq by Needham M 2020. For Bacterial contamination associated with cellular phones used by students were reported *Staphylococcus aureus* 27.7 % , *Staphylococcus epidermidis* 20.4% , *Pseudomonas aeruginosa* 17.6 %, *Escherichia coli* 12.1% and fungi 1.9 % were the most frequently identified microorganisms. In this study, several Microorganisms were isolated, *Staphylococcus epidermidis* 39(72%), followed *Streptococcus viridans* 6(11%), fungi 5(9%), *Streptococcus agalactiae* 2(4%), *Escherichia coli*, 2(4%).

In our study fungal contamination of students' cellular phones was found in (9%), this finding is lower than in contrast to , other studies. In the study by Kurli *et al*., 2018, fungi were found in 29%. Similar fndings were reported from a study from Japan with contamination of 31.7% (Furuhata, K. *et al*., 2016) , and a Nigerian study that revealed 30.6% contamination of university students' cellular phones (Akinyemi *et al*., 2009).

Conclusion

Cellular phones are usually used almost everywhere in society and in healthcare environments. Our results mention that these phones used by medical students could assist to transmit the pathogenic and non-pathogenic organisms. Therefore, we recommend introducing training programs an early stage in medical schools on intensive infection prevention and control in hospitals, increasing awareness of hand hygiene and regular cleaning of cellular phones, to reduce the risk of cross-contamination by these devices in healthcare settings.

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Appendix

Questionnaire

No of sample: ☐

Gender:

Male ☐

Female ☐

Nationality--

Academic year---

Specialty ---

Hospital Name --

Department --

No of Hours work --

Do you training on occupational safety in hospitals?

Yes ☐

No ☐

Result after culture:

Specie of microbial growth ---