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INVESTIGATING THE BACTERIAL CONTAMINATION OF MOBILE PHONES AMONG DENTAL STUDENTS IN FACULTY OF DENTISTRY _ TISHREEN UNIVERSITY*

Dentistry

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ABSTRACT

Introduction: Infection transmission in dentistry is an inevitable issue that occurs regularly and in different ways as dental students' mobile phones.
Purpose: This study aimed to assess the bacterial contamination of mobile phones among students in faculties of dentistry and arts and humanities at Tishreen University and to assess the effectiveness of the surface disinfectant (CaviWipes™) for decontamination.
Materials and Methods: A self-made questionnaire was completed by participants that consisted of 18 questions about the pattern of using mobile phones and their disinfection. (50) dental students as a test group and (15) students of faculty of arts and humanities as a control group were enrolled in this study. Sampling was taken from each participant's phone by a sterile cotton swab moistened by normal saline, two swabs were taken before and after wiping the devices with (CaviWipes™), then samples were transferred to the laboratory where they were cultured in (Nutrient agar, Blood agar, EMB) and allowed to incubate for 48 hours.
Results: About 92% of the test group and 60% of the control group believe that mobile phone can serve as a source of pathogens. The study showed that microbial growth was (100%) in all samples from participants mobile phones. The most commonly cultured microorganisms from the two tested groups were *Staphylococcus* spp. (70.8%), *Streptococcus* spp. (44.6%), *Bacillus* spp. (36.3%), Gram-negative *Bacilli* (23.07%), *Micrococcus* spp. (20.0%), other microorganisms like *Candida albicans* (18.46%), Spore-bearing gram *bacilli* (12.3%), *Klebsiella Pneumoniae* (9.23%) were isolated from test group mobile phones, while none of the control group mobile phones were infected by these organisms.Based on the findings of this study, a significant difference was found between (CFU/ Colony Forming Units) before and after wiping the devices with CaviWipes™ (P-value <0.05). CaviWipes™ were effective at 94% and caused the elimination of bacterial growth in the medium. Although, spore-bearing gram *bacilli* were resistant to decontaminants.
Conclusion: The present study revealed the potential role of mobile phones as a way of cross- contamination between patients and dental staff. Minimizing the use of mobile phones in clinical environments and regular disinfecting mobile phones are recommended.

KEYWORDS

Mobile Phone, Bacterial Contamination, Dentistry, Infection Control, CaviWipes

INTRODUCTION

Mobile phones have spread widely around the world and have become one of the most important and essential items in social and professional life. The mobile phone, in addition to the use of a phone, offers wide services such as messaging, emailing, internet, etc. [1] It has become the most preferred and most commonly used means of communication between dentists and patients due to the ease and quality of communication [2]. In contrast, the widespread use of this communication tool in hospitals and dental care centers with high rates of pathogens has become a major concern in many pieces of researches [3].

Preventing cross-infection is a basic issue in dentistry profession, in this regard the studies have shown that the dentistry care team is exposed to high risk of suffering infections such as *Mycobacterium tuberculosis*, Hepatitis B and Hepatitis C, *Staphylococci*, *Streptococci*, Herpes simplex virus type 1, Human Immunodeficiency Virus (HIV), mumps, influenza, and rubella [4]. Moreover, there are various ways for microorganisms' transmission in the dentistry domain; through direct contact from one person to another or indirect ways through contaminated equipment and devices and environmental surfaces that are not sterilized and disinfected regularly [5].

Contamination by airborne microorganisms may be possible. Furthermore, the transmission of these pathogens by different objects such as hands and mobile phones has reported [6].

Mobile phones are contaminated by the contact of the staff's hands, other objects or air microbial flora [7], and are rarely cleaned and are often touched while examining the patient and after it, and after touching it the washing of hands is not performed properly [3]. The mobile phone in each phone call is located at close contact with very contaminated areas of the human body including hands, mouth, nose and ear [8]. In addition to the moisture of the skin and the palms of the hands, the heat generated by the mobile phones is ideal for the growth of organisms on the surfaces of these devices at very dangerous levels [9].

Today, the mobile phone is a major public health risk and an important source of transmission of infection due to the presence of tens of thousands of diverse microorganisms on its surface [3]. Studies demonstrated that many infectious agents can survive for extended periods if they are not eliminated by regular disinfection of the surfaces [10].

There are currently no strict guidelines for the disinfection of these devices, which are used routinely and throughout the day inside and outside health care centers (medical and dental). Their use outside these centers plays an important role in the spread of diseases within communities [11]. It seems that emphasis on infection control practices during dental procedures is essential [12].

Many researchers have studied mobile phones contamination among healthcare workers and in the community. However, no work has been reported in our country on bacterial contamination on mobile phones used by dentists. Therefore, this study was carried out to evaluate the microbial contamination of mobile phones belonging to dentists in the faculty of dentistry at Tishreen university and to offer possible control or preventive methods of the spread of infection.

MATERIALS AND METHODS

This laboratory and cross-sectional study were performed among the students of the Faculty of Dentistry and Faculty of Arts and Humanities at Tishreen University from October 2018 to May 2019. The consent was based on the voluntary participation of people.

The study sample included (65) mobile phones divided into two groups:

1. The test group: included (50) mobile phones for the fourth and fifth-year students in the Faculty of Dentistry who provide dental treatment in all departments of the faculty.
2. The control group: included (15) mobile phones for students from the Faculty of Arts and Humanities from all academic years.

Random and unannounced visits were conducted during multiple days to both faculties for sample collection. At first, a self-made questionnaire was completed by participants, including the age, the sex of participants, their awareness about the importance of infection

control practices within the dental clinic, methods of disinfecting mobile phones and materials used.

Sterile cotton swabs that were impregnated with normal saline (0.009 g/L), were drawn on all external surfaces and sides of the mobile phones before disinfecting. Afterward, the mobile phones were wiped with CaviWipes™[4] (Canister of 160 pre-saturated towelettes of 17.15 cm x 15.24 cm dimensions).

CaviWipes™ are disposable ready-to-use cleaning and disinfectant wipes; non-woven, free from aldehydes, phenols and other toxic chemicals and pre-saturated with CaviCide™ solution which is consisted of: *Diisobutylphenoxyethoxyethyldimethylbenzyl ammonium chloride 0.28%, Ethylene Glycol Monobutyl Ether 1-5%, Water 70-80%, Isopropanol 17.2%.*

After allowing the devices to dry for 3 minutes (according to the manufacturer's instructions), samples were taken again with a moist cotton swab. To avoid cross-contamination, the researcher wore a new pair of surgical gloves when sampling each mobile phone.

The samples were sent to the microbiology laboratory in the Faculty of Science at Tishreen University for culturing and determining the type of bacteria within 30 minutes. The swabs were cultured on Nutrient agar, Blood agar, Eosin Methylene Blue (EMB), and were incubated at 37° C for 48 hours.

The isolated microorganisms were specified by using gram staining, morphology, catalase, and oxidase reaction, and all isolates were allocated to the appropriate genera. Data were analyzed using SPSS 23 and the results were compared using the T-test, ANOVA Test and Chi-square.

P <0.05 was considered statistically significant.

RESULTS

In this study; 50 mobile phones from the faculty of dentistry and 15 mobile phones from arts and humanities faculty were examined.

50 dental students were recruited in this study of which 42% (21) fourth-year students and 58% (29) fifth- year students (Table 1).

Table 1: Characteristics of the test group according to the academic year of dental students

Test Group	No.	Percentage
Fourth Year	21	42.00
Fifth Year	29	58.00
Total	**50**	**100.00**

According to participants' opinions; (92%) of the test group and (60%) of the control group believed that mobile phones can act as a source of pathogens with a significant difference between the two groups (P-value = 0.003) which is less than 0.05.

In response to the question: Do you ever touch your mobile phone with contaminated gloves? 40% of dental students responded positive answer.

The findings of this study showed that the growth of bacteria has existed in all samples taken from the mobile phones of dental students and students from the faculty of arts and humanities.

The results showed that Gram-positive bacteria were isolated in all samples while the percentage of Gram-negative bacteria was 37%.

The most common isolated bacteria from mobile phones of the test group and control group were: *Staphylococcus* spp., *Streptococcus* spp., *Micrococcus* spp., Gram-Negative *Bacilli., Bacillus* spp. (Figure 1).

Moreover, *Klebsiella pneumoniae* and *Candida albicans* were cultured in a number of the test group samples and the current study showed that none of the mobile phones of the control group were infected by these micro-organisms (Figure 1, Table 2).

Table 2: Chi-square test for the difference between the two study groups according to other microorganisms isolated from their mobile phones

Species	Test Group		Control Group		Total		Chi-square	P-value
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage		
Molds	15	30	1	6.67	16	24.62	3.385	0.066
***Penicillium* (Molds)**	5	10	0	0	5	7.69	1.625	0.202
***Aspergillus* (Molds)**	1	2	0	0	1	1.54	0.305	0.581
Yeasts	29	58	12	80	41	63.08	2.398	0.122
Fungi	8	16	2	13.33	10	15.38		
Fungi (*Candida*)	12	24	0	0	12	18.46	4.026	0.032

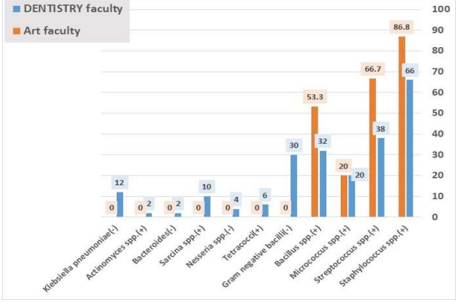

Figure 1: Percentages of bacteria isolated from mobile phones of the test group and the control group

Spore-bearing gram *bacilli* were isolated from many test group samples, whereas control group's mobile phones showed no growth for such spores as shown in Table 3.

Table 3: Chi-square test for the difference between the two study groups according to the isolation of bacterial spores

Isolation of Bacterial Spores	Test Group	Control Group	Total	Chi-square	P-value
No	42	15	57	4.524	0.033
	84%	100%	87.69%		
Yes	8	0	8		
	16%	0%	12.31%		
Total	50	15	65		
	100%	100%	100%		

According to the results of this study, (Cavi Wipes™) contributed to reducing the rate of bacterial growth in the medium significantly and was effective at 94% of the cases as shown in the following Table 4.

Table 4: Microbial growth before and after wiping mobile phones with Cavi Wipes™

	Decontamination Status	No.	Mean	Std. Deviation	Std. Error Mean	T-test	P-value
CFU	Before Decontamination	65	184.46	198.066	24.567	6.989	0.000
	After Decontamination	65	10.86	29.464	3.655		

DISCUSSION

Hospitals and clinics environments play a critical role in the transmission of microorganisms, either from one person to another or through contaminated equipment and devices, such as computers, mobile phones... etc. [6]

Mobile phones which are carried throughout the day and in all places are, according to experts, more contaminated than toilets and soles of shoes [10, 13].

In recent years, as a result of the widespread use of mobile phones, bacterial contamination of these devices become an important issue in the field of infection control. In this context, many studies have been conducted to investigate the rate of contamination of these devices within health care centers and more recently within dental clinics, which have come up with results, some of which are consistent with and some that differ with the results of the present study.

This study showed that 92% of the students of faculty of dentistry and 60% of students of faculty of arts believe that mobile phones may act as a source of pathogens in agreement with the study of Fard *et al.,*

[14] were 98% of students of faculty of dentistry and 62% of students from faculty of engineering had the same belief.

The study showed that 40% of dental students touch their mobile phones with contaminated gloves, a study conducted by Fard *et al.,* [14] showed that 36% of students and 10% of professors from dental college use mobile phones with unclean gloves, which is in agreement with the results of present study.

The results of our study showed that positive growth was found in all samples taken from mobile phones of two study groups. These results are consistent with the study of Shooriabi *et al.,* [15] which isolated bacterial growth in all samples taken from mobile phones of (77) students from faculty of dentistry and (10) normal citizens participating in this study. Al-Ghurabi *et al.,* [16] also mention that the rate of bacterial contamination of dental students' mobile phones was 100%.

Conversely, a study conducted by Kilic *et al.,* [17] which carried out on 106 mobile phones of health care staff, observed bacterial growth at 63.30%. In a similar study by Fard *et al.,* [14] 158 samples of 240 of mobile phones were infected by bacteria. The reason may be the different study environment, sample size, collection methods and the variety of laboratory procedures used in the study.

In respect of the type of isolated bacteria; the findings of this study showed that the highest frequency of bacteria observed on mobile phones of the two study groups, which is 70.80%, is related to *Staphylococcus* spp., and then *Streptococcus* spp. with 44.60%, *Bacillus* spp. with 36.30%, Gram- negative *Bacilli* with 23.07%, *Micrococcus* spp. with 20% and *Klebsiella pneumoniae* with 9.23%.

In this regard, some studies have also been performed that have the results almost similar to the results of this study. In the study of Bhoonderowa *et al.,* [18] the most common isolated microorganisms respectively included: *Coagulase*-negative *Staphylococci* (69.30%), *Micrococci* (51.80%) and *Klebsiella* (1.50%).

In the study of Singh *et al.,* [2] *Coagulase*-negative *Staphylococci* were isolated at 78% from 50 mobile phones of students and dental staff in faculty of dentistry in India, besides that, the other observed bacteria included: *Staphylococcus aureus, Bacillus* spp., *Acinetobacter, Pseudomonas, Micrococci* and *Diphtheroid.*

In a research work by Trivedi *et al.,* [19] 46.66% of mobile phones of the hospital staff were contaminated with bacteria such as *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Enterococcus*. While *Bacillus* spp. was the most common observed bacteria with 23.40% in the study of Shooriabi *et al.,*

[15] followed by *Coagulase*-negative *Staphylococci* with 11.70% and *Escherichia coli* with 7.80%.

Other microorganisms were isolated from the samples of 65 mobile phones of the two study groups, which included: Molds, Yeasts, Fungi. However, *Candida albicans* were cultured from the mobile phones of the test group without being isolated in control group samples in consistent with the study of Fard *et al.,* [14] which showed that none of the mobile phones of engineering students were infected by *Candida albicans* and *Pseudomonas*.

Similarly, a study by Coutinho *et al.,* [20] revealed a high fungal growth rate among mobile phones for citizens in a city in Brazil. This study isolated (34) fungal microscopic species from the samples.

The present study showed a significant reduction in the average number of former colonies after wiping mobile phones with disinfectant wipes. CaviWipes™ was effective at almost 94% of cases.

Unfortunately, this is currently no guidelines for use on mobile phones of health care workers, different ways used by people to clean and sterilize their mobile.

CONCLUSIONS

Generally, the results of this study showed that the bacterial contamination ratio of the mobile phones of students of Faculty of Dentistry and Arts and Humanities at Tishreen University, Lattakia city is 100 percent, and the most frequently isolated bacteria were: *Staphylococcus* spp., *Streptococcus* spp.

RECOMMENDATIONS

- Emphasis should be given on strict guidelines regarding mobile phone use and disinfection in dental care settings.
- Hand washing should be practiced both before as well as after the clinical procedures.
- Gloves should be worn and changed for each patient.
- Mobile phone use in between the clinical procedure should be avoided. If it should be used, then thorough hand washing before and after the use of the mobile phone is necessary.
- We recommend disinfecting mobile phones and non-porous surfaces and fixtures in the dental clinics with CaviWipes™ because of its proven effectiveness. CaviWipes™ is ideal for operating rooms, surgical centers, neonatal units, medical and dental operatories and other critical-care areas according to the manufacturer's claim.

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