

# Bacterial Contamination Associated with Mobile Phones: Students at Knowledge University as a Case Study

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## ABSTRACT

Bacterial cells adhere to mobile phone surfaces and could form organized colonies. Once the bacteria move to the mobile phone they can live well because these surfaces are hard to clean. This research, included isolation of pathogenic bacteria from mobile phones of Knowledge University students. A total of 100 mobile phones of Knowledge university staff and students were selected for this study. The single sterile swab stick was moistened with sterile normal saline solution and moved over the surfaces of mobile phones. The swab sticks were immediately transported to the laboratory. All swabs were cultured in (Nutrient agar), Then incubated for 24 hours. The obtained bacterial colonies were subjected to Gram stain, and colonial characteristics for their identification. Biochemical Examination for selected colonies has been done. From a total 100 mobile phone swabs. A total of 138 bacterial isolates were recognized as: 47 bacterial colonies of Staphylococcus aureus, 33 bacterial colonies of Staphylococcus epidermidis, 23 bacterial colonies of Pseudomonas aeruginosa, 19 bacterial colonies of Escherichia coli, 7 bacterial colonies of Streptococcus spp., 6 bacterial colonies of Bacillus subtilis, 2 bacterial colonies of Neisseria and 1 bacterial colonies of Enterobacter aerogene. The study revealed that bacteria can survive on mobile phones of students and the contaminated mobile phones are able to transport microbes that may be able to produce disease. There is a need for preventive care to reduce the impact of contaminated mobile phones on the spread of microbes and control measures should be applicable for this reason.

**Keywords:** Bacteria, Contamination, Knowledge University, Mobile phones, Pathogens.

## 1. Introduction

The rapid development of technology especially on the scale of mobile phone manufacturing causes mobile phones to become indispensable personal property in everyday life, where it has been widely spread to be accessible to all age groups. Therefore, their uses have become beyond the

purpose they were designed for, It has become an alternative to television, camera which are making these devices represent a warehouse for a wide range of pathogens [1].

Bacterial cells could readily adhere to mobile phone surfaces and could form organized colonies. Once the bacteria move from the hands to the mobile phone they can

live well because these surfaces often get hotter when the device is used. Then the bacteria move from the surface of the phone to the hands, then into the ears and faces where they can contaminate any scratches or open wounds [2].

It has been shown that a significant number of germs could be transferred between the hands of mobile phones users [3].

The frequent use of cell phones in a diversity of sites raises the opportunity for cross contamination, especially if no hygienic measures and safety practices [4]. The most prominent bacteria discovered on the surface or screen of the smart phone, *E. coli* (E.coli), also known as fecal coliform bacteria, which are usually found in the human intestines. Fecal-oral transmission is the major route in which pathogenic strains of the bacterium cause disease. Their infection leads to severe cramps, diarrhea, vomiting, and possibly even more severe symptoms [5].

There are also *Staphylococcus aureus*, a major agent of health-care-associated infections that causes a wide range of diseases from mild skin infections to life-threatening conditions and it is transmitted by contact with infected skin or mobile phones [6].

And for *Streptococcus*, there are over 50 species are recognized in this genus currently, some of these species are responsible for many cases of bacterial pneumonia, pink eye, endocarditis, meningitis, and necrotizing fasciitis [7].

Finally, *Pseudomonas aeruginosa* is one of the most common species on the devices, and spread in hospital equipment and portable devices. It has a high resistance to treatment and especially prevalent in intensive care areas, so doctors are keen to evacuate these areas of portable devices [8].

Among the types of contaminants on smart phones there are also mold, which affect the respiratory system and lead to shortness of breath, nasal congestion, fever, and in rare cases lung infection [9].

That importance of this subject is that many researchers have carried out various studies, all of which are involved in the study of microbial contamination on mobile phones, some of their studies focused on healthcare workers [10] others were interested in undergraduate students [11].

While other studies have expanded to determine the effect of antimicrobial solutions on isolated microorganisms [12].

A number of studies have reported 5-21% of mobile phones belonging to healthcare workers to be contaminated, and therefore to be a significant source of the microorganisms

responsible for nosocomial infections [13]. Recent study published in the proceedings of the 5th medicine Conference in Gaza City - Palestine revealed that a large percentage of the telephones of health workers showed the presence of pathogenic bacteria on their telephone surface [14].

In addition, mobile phones are common among higher education students as a means of communication, which they use for calling, writing messages, taking pictures or conducting some applications in their field of specialization [15].

Therefore, this study was aimed to identify microbial contamination of mobile phones among students of Knowledge University and to determine the microbial species associated with these phones.

## 2. Methods

### 2.1. Sampling

Samples were collected with sterile swabs moistened with sterile normal saline solution over a period from 7 April to 30 April 2019. One hundred mobile devices were included in this study. The wet swab was rolled over the exposed surfaces of the mobile phones. Care was taken to ensure that all keyboard, screen, mouth, earpiece, side, and back of cell phones were properly swabbed because these areas are most frequent locations for touching skin, fingers and face during phone call, the samples were collected from different people such as: employers, students, and teacher assistants in Knowledge University.

### 2.2. Sample inoculation and bacterial identification

The samples were immediately transferred to the laboratory of microbiology and were inoculated on plates of Nutrient agar the plates were incubated aerobically at 37°C for 24-48 hours. After incubation, the plates were examined for description of colonial morphology and for growth of bacteria gram-positive and gram-negative.

The slides were prepared from each different colony observed on the plates and Gram staining was performed.

Biochemical Examination the selected colonies have been underwent to some biochemical tests for the bacteria, such as oxidase test, indole test, urease test, citrate test, triple sugar iron test, catalase, and coagulase test were performed [16].

## 3. Results

One hundred mobile phones which were used by Knowledge University students and staff were examined. From the 100 mobile phone swabs, pure cultures were

detected on most of the inoculated plates and mixed isolates appeared in a small number of plates. A total of 138 isolates were recognized as: 47 bacterial colonies of *Staphylococcus aureus*, 33 bacterial colonies of *Staphylococcus epidermidis*, 23 bacterial colonies of *Pseudomonas aeruginosa*, 19 bacterial colonies of *Escherichia coli*, 7 bacterial colonies of *Streptococcus* spp., 6 bacterial colonies of *Bacillus subtilis*, 2 bacterial colonies of *Neisseria* and 1 bacterial colonies of *Enterobacter aerogene*, Table 1.

Table 1: Microorganisms isolated from students' mobile phones.

Isolated Bacterial species	Numbers	Percentage
<i>Staphylococcus aureus</i>	47	34%
<i>Staphylococcus epidermidis</i>	33	24%
<i>Pseudomonas aeruginosa</i>	23	17%
<i>Escherichia coli</i>	19	14%
<i>Streptococcus</i>	7	5%
<i>Bacillus</i>	6	4 %
<i>Neisseria</i>	2	1%
<i>Enterobacter aerogenes</i>	1	0.7%

A total of 75 mobile phones samples from students attending the science college laboratories and 25 samples from students mobile attending only sessions for basics science were cultured, out of which, (35 isolates) and (12 isolates) of *Staphylococcus aureus* was the predominant organism isolated from the mobiles. The distribution of bacterial isolates among those groups is shown in Table 2 and Fig. 1.

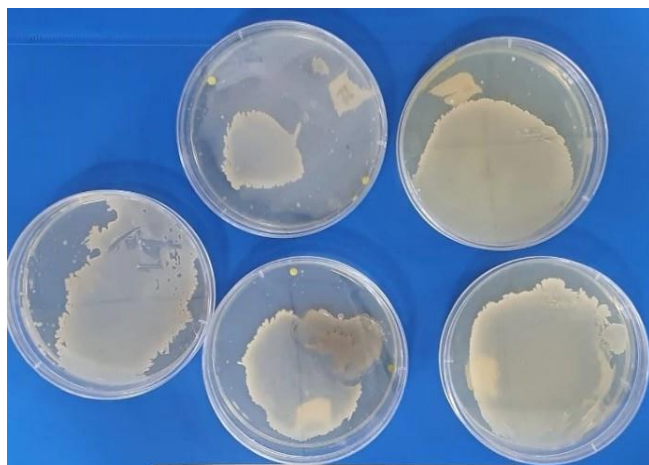


Fig.1: Different colonies of bacteria isolated from mobile phones.

#### 4. Discussion

Mobile phones are one of the dirtiest things we use every day, that they carry a number of bacteria, which about 7 times greater than the toilet seat, Where people rarely clean their phones, so bacteria and other germs continue to accumulate by building colonies, so these phones operate as a reservoir and carrier for the bacteria which can survive on non-living surfaces for long periods up to several months [17].

These pathogenic bacterial isolates have many virulence factors and adhesion factors and they have ability to form biofilms that help them to survive in host environment and non-living surfaces [18].

People spend much of their time on their phones when they press them, and bring them closer to their faces. In addition, the hand is an important factor in transmitting bacteria through contact with other contaminated objects or when shaking hands with others [19].

During this research, pathogenic bacteria were isolated. It was observed the dominance of *Staphylococcus aureus*, followed by *Pseudomonas* as well as *E.coli*, and *Streptococcus* spp. These results are coincided with a study that was reported by Bhat et al. [20] with the isolation of *S. aureus* and *E. coli*. In addition to Abdelraouf et al. [21] who confirmed that the overall percentage of positive cultures was 71.6%, and *Staphylococcus aureus* was the most predominant isolate (with 27%). In a similar study of Vivekanandan [22]. for the sample of mobile phones owned by veterinary undergraduates concluded that one or more species of bacteria were found in all mobile phones such as: Coagulase negative *Staphylococcus* spp., *Pseudomonas*, *Bacillus* spp. Coagulase positive *Staphylococcus* spp., *Staphylococcus aureus*, *Klebsiella*, *Proteus*, *Acinetobacter*, *Enterobacter*, *Flavobacterium*, *E.coli* and *Citrobacter*. Furthermore, the presence of different microorganisms which has been detected by Soto et al. [23].

*Staphylococcus aureus* is known to cause many diseases ranging from minor skin infections to more serious diseases, including pneumonia, bacteremia, septicemia, meningitis [24].

Gram-negative sepsis is most commonly due to *E. coli*, *Enterobacter* spp, and *Pseudomonas aeruginosa*, 20 which have been also isolated in high rate in this study. Isolation of *Bacillus subtilis* was also determined frequency of occurrence as a vital organism in the spoilage of food [25].

Table 2: Number and type of microorganisms isolated from mobile phones of students attending.

Type of source	No. of sample collected	No. of isolated colonies	Isolated Bacteria	No. of isolated bacteria	Percentage
Students Attending Laboratories	75	108	Staphylococcus aureus	35	32.4%
			Staphylococcus epidermidis	22	20.3%
			Pseudomonas aeruginosa		
			Escherichia coli	22	20.3%
			Streptococcus	17	15.7%
			Bacillus	6	5.5%
			Neisseria	3	2.7%
			Enterobacter aerogenes	2	1.8%
Students Attending Basic Sciences Session	25	30	Staphylococcus aureus	12	40%
			Staphylococcus epidermidis	11	36.6%
			Pseudomonas aeruginosa		
			Escherichia coli	1	3.3%
			Streptococcus	2	6.6%
			Bacillus	1	3.3%
			Neisseria	3	10%
			Enterobacter aerogenes	0	
Total	100	138		138	

Undoubtedly, this contributes greatly to food contamination if food is prepared or eaten with infected hands.

The presence of *Neisseria* spp and *Enterobacter aerogenes* in this research may indicate that a student or one of his family has a satisfactory condition, so he contributes to transfer these types of bacteria to the college. Although it was isolated in a few percentages, it cannot be underestimated because it is a pathogenic bacterium causing many diseases to humans.

The other non-pathogenic bacteria, which were isolated in this research, were *Staphylococcus epidermidis*. Where most of them are found naturally on the skin and mucous membranes of humans and animals, so it is normal to move to their mobile phones because of the frequent use with not paying attention to health aspects and cleaning devices. These bacterial species are normal in nature but opportunistic. If the appropriate conditions were available, it will be transformed into a pathogenic form and causes diseases. In a study conducted by Batool et al [26] in Baghdad University to evaluate the microbial contamination of mobile phones belonging to dentists, states that the most common microorganisms detected were *Staphylococcus epidermidis*, *Micrococcus* spp., *Candida albicans* and *Aspergillus niger*.

In addition, the current research observed that the isolation ratio in science laboratories students were higher than the basic science students and this is due to presence of biology students in laboratories and their frequent deal with

different microorganisms and contact with many contaminated objects.

In the recent research, it was concluded that the mobile phone device is a means of transmitting diseases because it represents a storehouse for many microorganisms, and because this device is a necessary mean of communication, we advise that the device must be cleaned at least once a day especially if someone else uses it. Furthermore, is advisable to follow hygiene habits to prevent germs, such as washing hands regularly and not taking the phone to the contaminated places like bathrooms.

## 5. Conclusion

This study shows that bacteria colonized mobile phones of medical students and the contaminated mobile phones are able to transport microbes that may be able to produce serious disease. There is a need for preventive care to decrease the impact of contaminated mobile phones on the spread of microbes and control measures should be applicable for this reason.

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