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BACTERIAL CONTAMINATION ON MOBILE PHONE DEVICES OF UNDERGRADUATE STUDENTS IN AL- QURNA EDUCATION COLLEGE- BASRAH UNIVERSITY

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ABSTRACT

The world around us is containing of many kinds of microorganisms since the undergraduate students are using their mobile phones on daily basis and most of the time. So these devices have become a potential source of microorganisms to them. Therefore, this study was implemented to determine the bacterial contamination existing on mobile phones, which are used by undergraduate students in Qurna - Education College in Basra University. Eighty samples from mobile phones that used by undergraduate students in the biology and Arabic departments were collected by using wet sterile swabs in transporting media to detect the presence of bacteria, divided into forty samples per department (20 female and 20 male). The swabs have been cultured on a different media in order to determine all contaminated bacteria on these devices. At the end, the bacterial isolates have been identified with Vitek2. The study results have showed that mobile phone devices from both departments (Female & male) have been contaminated with at least one or more bacterial isolates. Forty-seven of isolates were obtained among eighty samples, some of them were non- pathogenic such as *Staphylococcus saprophyticus* and *Staphylococcus epidiermidis* and others were pathogenic such as *Staphylococcus aureus, E.coli, Pseudomonas aeruginosa, Pantoea spp and Salmonella typhi.* Also, the results indicated that the percentage of contamination of mobile phones in the department of biology were 72.5% which is higher than Arabic department percentage (45%) as the results of the gender factor showed that the percentage of contamination for males and females were almost the same in biology department (51.72 : 48.27%). On the contrary, the percentage of contamination in Arabic department for males were higher than females (61.11: 38.88%).

KEYWORDS: Bacterial-contamination, mobile phones, students, microorganisms.

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 and game consoles 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. These bacteria are only a reflection of the bacteria that live on our bodies, whether they exist naturally or as evidence of certain infection. Once the bacteria move to the mobile phone they can live well because these surfaces are hard to clean and often get hotter when the device is used. then the bacteria move from the surface of the phone to the hands, even after washing, and then into the ears and faces where they can contaminate any scratches or open wounds or even other persons who communicate the speaker among themselves.[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*, also known as faecal coliform bacteria, which are usually found in the human intestines. Faecal–oral transmission is the major route in which pathogenic strains of the bacterium cause disease. Their infection leads to severe cramps, diarrhoea, 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]

There are also coliform bacteria that are present in human and animal wastes, and are found in soil and plants. As long as they remain small, they may not have serious consequences. Their presence is used to indicate that other pathogenic organisms of faecal origin may be present.[8]

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.[9]

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. The yeast is also spread on these devices, a type of fungus that lives anywhere on the body. But they may cause severe itching on the skin, as well as vaginal discharge.[10]

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[11],[12], others were interested in undergraduate students.[13] While other studies have expanded to determine the effect of antimicrobial solutions on isolated microorganisms.[14]

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.[15],[16] 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.[17]

In addition, mobile phones are common among higher education students as a means of communication, which they use for dialling, writing messages, taking pictures or conducting some applications in their field of specialization.[18],[19]

Therefore, the aim of this research is to conduct a survey of a number of mobile devices for undergraduate students by isolating and diagnosing the most important bacterial species on the surfaces of these devices, and to give recommendations to reduce the contaminations of these phones.

MATERIALS AND METHODS

A. Samples collecting

Eighty samples from mobile phones that used by undergraduate students in the biology and Arabic departments were collected by using wet sterile cotton swabs after make sure that the devices are not cleaned in advanced before taking the swab, then the samples transported immediately with a transport media to the laboratory for culturing.

B. Identification of Bacteria

The bacterial isolates have been identified according to the below laboratory steps:

1. Swabs directly streaking on blood agar plates then incubated aerobically at 37ºC for 24 hours. After incubation the isolated colonies were then re streaked on to various selective media; such as macConkey agar, mannitol salt agar, eosin methylene blue and salmonella - shigella agar. Cultural characteristics (color, size, and colony morphology) were observed.
2. During microscopic examination, the slides were prepared from each different colonies observed on the plates and Gram staining was performed. The results such as the gram positive or gram negative, shape and arrangement of the bacteria were observed from this exam.
3. Biochemical Examination

The selected colonies have been underwent to some biochemical tests for the bacteria, which were initially verified then definitively diagnosed with Vitek2.

RESULTS

This research confirmed that most of mobile devices of students for both departments and genders were contaminated with at least one or more bacterial isolates.

Out of eighty sample a forty-seven samples have given positive result, meanwhile there was no grow in the balance samples as it shown in below table -1 and figure -1.

Table 1: Isolation results from students mobile phones for both departments.

Isolation results	Biology department		Arabic department	
	Number	percentage	Number	Percentage
Growth	Growth	29	72.5%	18
No growth	No growth	11	27.5%	22
Sum	Sum	40	100%	40

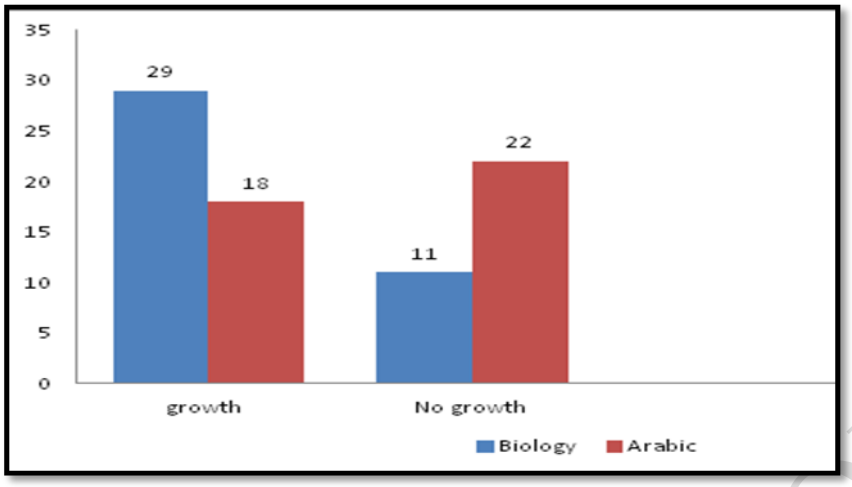

Figure 1: Isolation results from students mobile phones for both departments.

In Biology department, the results of the bacterial isolation showed that out of 29 positive samples, there were 13 isolates from *Staphylococcus aureus*. Where the other isolates were 8 of *Staphylcoccus epidiermidis*, 6 *E.coli* and one isolate for each of the *Peudomonus aeroginosae and Pantoea spp*. as shown in Table-2 and Figure-2.

Table 2: Numbers and ratio of bacterial isolates from biology department.

	Bacterial species	Numbers	Percentage
1	*Staphylococcus aureus*	13	%44.82
2	*Staphylcoccus epidiermidis*	8	%27.58
3	*E.coli*	6	%20.68
4	*Pseudomonas aeruginosae*	1	%3.44
5	*Pantoea spp*	1	%3.44

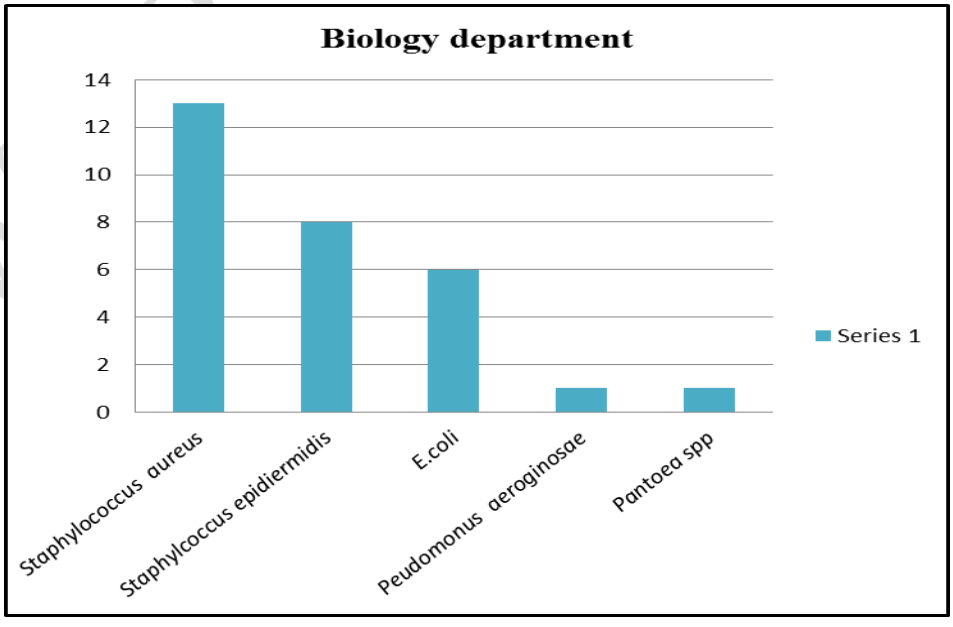

Figure 2: Bacterial isolates from Biology department.

While in Arabic department, mobile phones were contaminated with pathogenic bacteria such as Staphylococcus aureus, E.coli and Salmonella typhi as well as its contaminated with non-pathogenic species as shown in Table -3 and Figure-3.

Table 3: Numbers and ratio of bacterial isolates for Arabic department.

	Bacterial species	Numbers	Percentage
1	*Staphylococcus aureus*	9	50%
2	*Staphylococcus saprophyticus*	5	27.77%
3	*E.coli*	3	16.66%
4	*Salmonella typhi*	1	5.55%

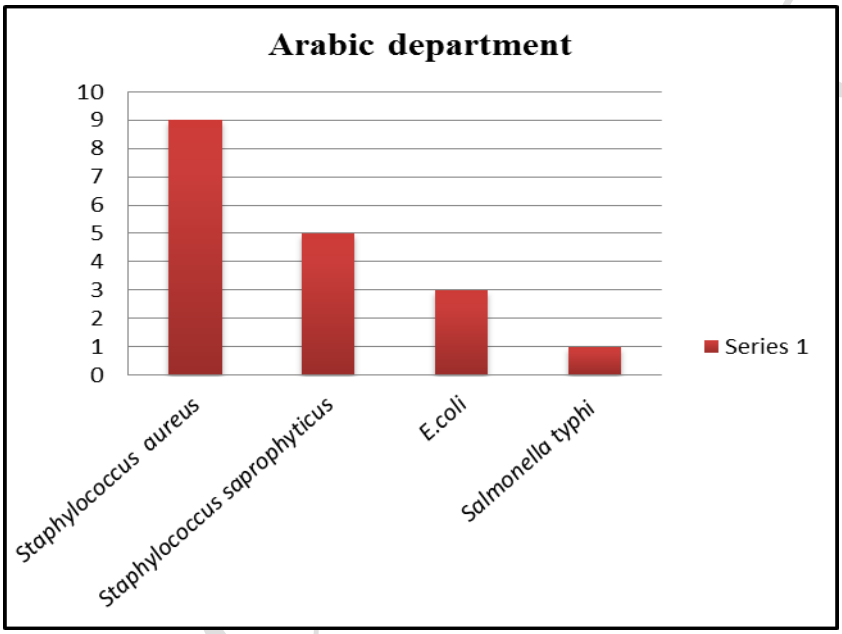

Figure 3: Bacterial isolates from Arabic department.

Regarding to the gender factor in the Arabic department, this research proved that the isolation ratio from the males is the highest (55%), while the females was (35%) as shown in Table -4 and Figure -4.

Table 4: Isolation results according to gender in Arabic department students.

Isolation results	Number	Ratio
Female	7	38.88%
Male	11	61.11 %

While in Biology Department, the numbers and ratio of bacterial isolation were approximately equal with slightly different among the students as shown in Table -5 and Figure -4.

Table 5: Isolation results according to gender in Biology department students.

Isolation results	Number	Ratio
Female	15	51.72 %
Male	14	48.27%

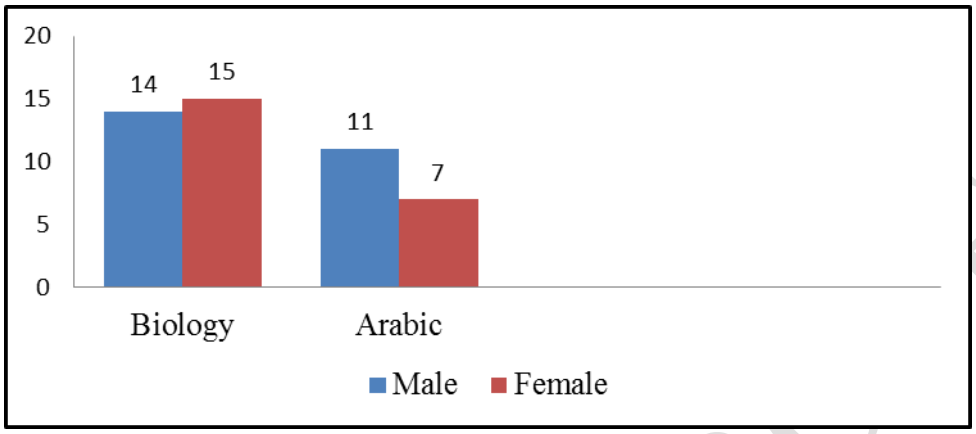

Figure 4: Bacterial isolates according to gender in both Arabic and biology departments.

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.[20],[21] 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.[22]

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.[23]

During this research, pathogenic bacteria were isolated. It was observed the dominance of Staphylococcus aureus, followed by *E.coli* as well as to *Pseudomonas, Salmonella and pantoea spp*. These results are coincided with a study that was reported by Bhat et al.[24] with the isolation of S. aureus and E. coli. In addition to Abdelraouf et al.[25] 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 Annet Viveka,[26] for the sample of mobile phones owned by veterinary undergraduates with equal proportion of male and female students. He 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.[27]

When we compare the results of this research with previous studies, we note that there is no study confirmed the presence of *Salmonella and pantoea spp*. However, their presence 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 percentage, it can not be underestimated because it is a pathogenic bacteria causing many diseases to humans.

The other non-pathogenic bacteria, which were isolated in this research, were *Staphylcoccus epidiermidis* and *Staphylococcus saprophyticus*. 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,[28] 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 Biology were higher than the Arabic department and this is due to presence of biology students in laboratories and their frequent deal with different microorganisms and contact with many contaminated objects.

Our results regarding to gender factor coincided with the study of Enass[29] (University of Baghdad - college of science), which concluded the ration of contamination in mobile phones for males (61.11%) more than for females (38.88%). While the results are not compatible with the results of researcher Hossam[30] (University of Baghdad – Iraq), which confirmed that there was no significant difference ($P < 0.05$) in types of microorganisms and their percentage frequency of occurrence between mobile phones for males and females.

CONCLUSION

In the recent research, it was concluded that the mobile phone device is a means of transmitting diseases because it represents a repository 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.

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