

## Study of Microbial Contamination of Mobile Phones Used by University Students

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### Abstract

Cell phones are widely used in our lives, they are contaminated by several pathogenic bacteria. This study aimed to investigate the bacterial contamination of mobile phones with different pathogenic bacteria and non-pathogenic bacteria and determine the antibiotic resistant strains. Two hundred mobile phone samples of university students during the month from March to June were at Mosul university swabbed. Samples were cultured on standard bacteriological media. Samples were collected from mobile phones of 200 university students (150 male and 50 female) through the period from (March to June 2019), The number of isolations were 242 of which 164 were from mobiles of males and 78 were from mobiles of females. The result showed that contamination of mobile phones was 100% and some of the mobiles were exhibit polymicrobial contaminates as 242 bacterial isolates were obtained 214 of the isolates were gram- positive bacteria with coagulase Negative Staphylococci forming the highest number of isolates followed by coagulase-positive *Staphylococcus aureus* and the lower isolated gram-positive bacteria was *Kocuria rosea* forming 6.1% of isolates gram- negative bacteria with *Acinetobacter Lowffi* forming the highest isolate 4.9% and *E. coli* the lowest 2.9 %. The antibacterial sensitivity of isolates to antibiotics exhibits the prevalence of MDR among the isolates 69.9%. The result also showed that Ciprofloxacin was the most effective on all isolates *Staphylococcus aureus*, most of the isolates were resistant to amoxicillin, the other antibiotics showed different sensitivity against gram positive and negative bacteria.

Keyword: Mosul University Students, Bacterial contamination, Mobile phone pathogenic.

### 1. Introduction

Mobile phones are known as cellular phones used for personal connection. The increased in using this device cause many changes in our life. Mobile phone markets showed an increase distribution all over the world as their number reaches 3.2 billion [1] and the number of cellular phone users reached out 33.5 million in Iraq.

These phones were exposed to contamination as they were handled by different personal, different microorganisms contaminated them

that produced a good carrier to transition of microbes particularly in the skin and assisting the extent of those germs from one person to another [2].

Constant contact with mobile phones leads to the generation of heat, which in turn provides a breeding ground for the multiplication of contaminated microorganisms that are usually found on the skin. [3]. because they come in contact with the contaminated human body parts with hands to hands and with contaminated human body parts, like mouth, nose and ear

during the use. the contaminating bacteria will stick to the surface of the cellular phone and may lead to the formation of colonies [4, 5]. The Gram-positive bacteria are readily transmitted followed by viruses and then by gram- negative bacteria, sanjib and coworkers reported a significant association between the occurrence rate of Methicillin-resistant *Staphylococcus aureus* and multidrug resistance *Staphylococcus aureus* with various attributes of the users the handling method of the mobile phones and with the length of time of using the phones [6]. Other study isolated eleven species of bacteria such as coagulase negative *Staphylococcus* spp. At high rate (87.5%) followed by *Bacillus* spp 60%, *Pseudomonas* 50%, coagulase+ *Ve Staphylococcus* spp (22.5%), *Klebsiella* (22.5%), *Acinetobacter* (15%), *Proteus* (12.5), *Staphylococcus aureus* (5%),

*Flavobacterium* (5%), *Enterobacter*, (2.5%), *Citrobacter* (2.5%) and *E.Coli* (2.5%) were identified from the phones sample [4]. While Bodena *et al* 2019 recorded that *Staphylococcus aureus* and *Klebsiella* is the most common bacterial isolation with the spread of multidrug-resistant bacteria (69.9%) as half of the bacterial types which were gram- negative and grampositive are resistant to ampicillin sulfamethoxazole and trimethoprim [7].

[2] concluded that mobile phones may act as the source of the nosocomial pathogen [8] indicated the need to discourage the participation of mobile phones and use them while eating and emphasized that personal hygiene is very important because bacteria isolated from mobile phones cause transmission between humans.

**Aim of the study:** The present study aimed to research the bacterial contamination of Mobile phones with different pathogenic bacteria and non-pathogenic bacteria and determine the antibiotic resistant strains.

## 2. Methods

### 2.1 sample collection and analysis

Samples were collected from the mobile phones of 200 university student (150 male and 50 female) through the period from (March to June 2019) in the biology department. The samples were collected aseptically using sterile swabs moistened with sterile saline and rotated over all the mobile phone without cover from both sides. The samples were transported immediately to the microbiological laboratory, and were cultured by streaking on Nutrient, MacConkey and Mannitol salt Agar. All samples were incubated at 37 C for (24-48) h. The appearing bacterial growth were identified by examination of gram-stained smears for determination of technique Then identification by vitek.

### 2.2 Antibiotic Sensitivity test

The antibacterial resistance of the isolates was studied for (9) Antibiotics using the standard disc diffusion method (SDM) [9].

## 3. Result and Discussion

Mobile phones of some Student Science collage were examined for bacterial contamination, as the continuous use of these phones has a major role in the transmission of diseases. The results of bacterial contamination of all mobile phones were 100%, several of the mobiles were contaminated by more than one bacterium, hence the culture of isolated bacteria was polymorphic as the number of isolates 242 from 200 swabs as 26 swabs sample was contaminated with multiple bacterial strains of species, 214 isolates belong to Gram-positive and only 28 isolates were Gram-negative including *E. coli* (7).

*Acinetobacter lowffi* (12), and *Pseudomonas fluorescens* (9) as it is indicated in table (1).

**Table 1.** The result of isolated bacteria from the mobile phone.

Bacteria	Number of isolated colonies	percentages of isolated
1- <i>Staphylococcus aureus</i>	19	7.8
2- <i>Staphylococcus saprophyticus</i>	37	15.2
3- <i>Staphylococcus epidermidis</i>	40	16.5
4- <i>Staphylococcus haemolyticus</i>	14	5.7
5- <i>Staphylococcus hominis</i>	14	5.7
6- <i>Staphylococcus cohnii</i>	13	5.3
7- <i>Staphylococcus auricularis</i>	12	4.9
8- <i>Staphylococcus capitis</i>	15	6.1
9- <i>Acinetobacter haemolyticus</i>	12	4.9
10- <i>E. coli</i>	7	2.9
11- <i>Micrococcus leuteus</i>	23	9.5
12- <i>Kocuria rosea</i>	15	6.1
13- <i>Acinetobacter lowffii</i>	12	4.9
14- <i>Pseudomonas fluorescence</i>	9	3.7

**Table 2.** Statistical difference between male and female.

Bacteria	percentages of isolated	percentages of isolated from male	percentages of isolated from Female
1- <i>Staphylococcus aureus</i>	7.8	7.3	8.9
2- <i>Staphylococcus Saprophyticus</i>		15.2	17.0
3- <i>Staphylococcus epidermidis</i>	16.5	18.9	11.5
4- <i>Staphylococcus haemolyticus</i>		5.7	5.4
5- <i>Staphylococcus hominis</i>	5.7	2.4	12.8
6- <i>Staphylococcus cohnii</i>	5.3	1.	12.8
7- <i>Staphylococcus auricularis</i>	4.9	5.4	3.8
8- <i>Staphylococcus capitis</i>	6.1	4.2	10.2
9- <i>Acinetobacter haemolyticus</i>	4.9	7.3	Zero
10- <i>E. coli</i>	2.9	4.2	Zero
11- <i>Micrococcus leuteus</i>	9.5	6.7	15.3
12- <i>Kocuria rosea</i>	6.1	7.3	3.8
13- <i>Acinetobacter lowffii</i>	4.9	6.0	2.5
14- <i>Pseudomonas fluorescence</i>	3.7	5.4	Zero

One hundred seventy – six isolates of the contaminated bacteria belong to different species of Staphylococci including *Staphylococcus epidermidis* (16.5) of the total isolate and (22.7 %) of *Staphylococci*, then *Staphylococcus saprophyticus* (15.2%) and (21%) of both respectively. *Staphylococcus aureus* isolates forming 7.8% of all isolates and 10.8% of *Staphylococci* and the remaining bacterial species were isolated at lower rates as

appeared in table (1) and most of the isolates were obtained from males except *Staphylococcus hominis* as it was isolated as a higher rate from females to male 4:10 in female and *Staphylococcus cohnii* as 10 female isolates were obtained to 3 from male and difference were statistically calculated in Figure 1,2 and 3 These results were coordinated with [11] and [12].,

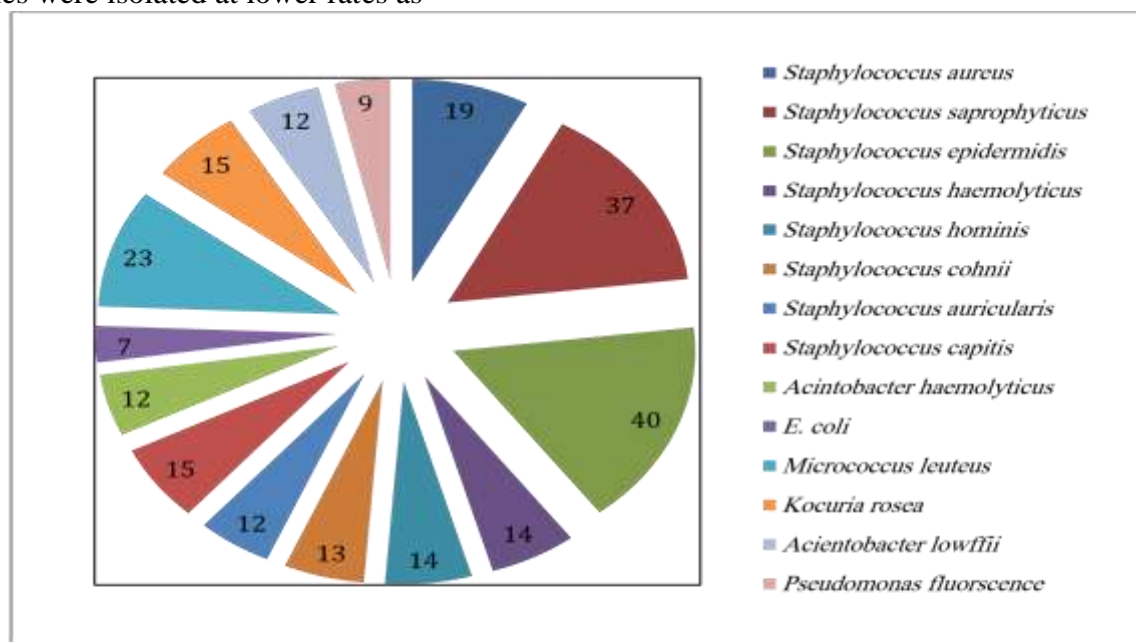


Figure 1. Number of Isolated colonies.

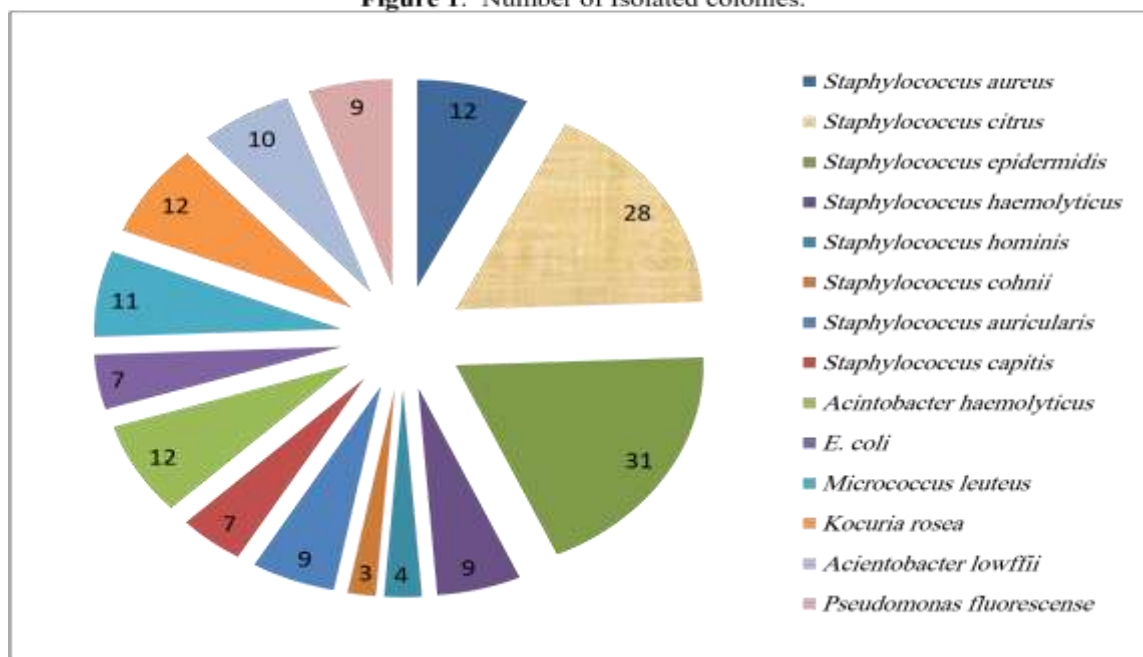
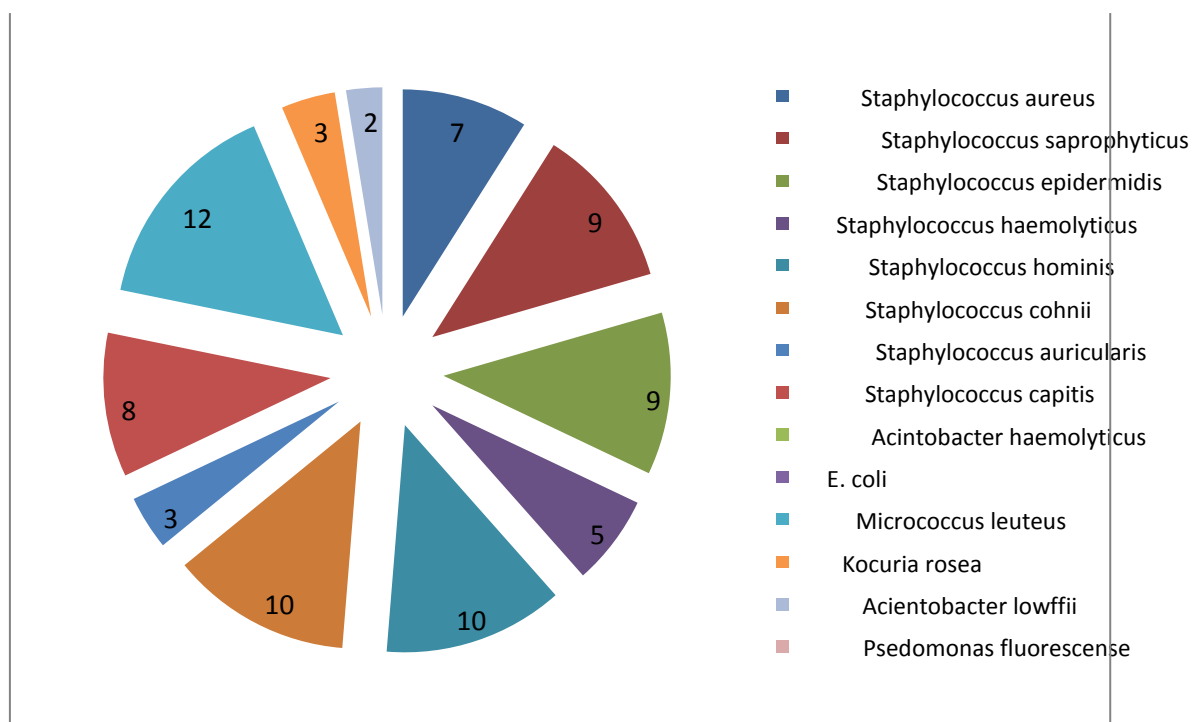


Figure 2. Number of Isolated colony in Male.



**Figure 3.** Number of Isolated colony in Female.

Most of the Staphylococcal isolates belong to coagulase negative *Staphylococci* which formed about 82% of all *Staphylococci* which is consistent with the results of [13]. The other contamination bacteria include *Micrococcus Leuteus* and

*Kocuria rosea* which were isolated at a rate of 9.5 % and 6.1% respectively, and gram negative bacteria including

*Acinetobacter haemolyticus* 4.9% , *E.coli* 2.9% , *Acinetobacter Lowffii* 4.9% and *Pseudomonas fluorescense* (3.7%) , 30% , 17.5% , 30% and 22.5 % of the Gram- negative isolates for all the Gram negative, These types of isolated bacteria may be part of the normal flora of the skin and nose and can be transmitted as a source of pathogens [4] and may cause digestive diseases, skin problems, urinary, eye and ear infections as several of *Staphylococcus aureus* causes different diseases as pneumonia, meningitis, other bacteria Gram-negative can cause sepsis which may be caused by *E. coli* and *Pseudomonas aeruginos* [11].

This result is similar to others [14, 15] who found that 100% of mobile phones of student were contaminated with bacteria and also with [12] as they reported 100% contamination of phones of health professionals in eastern Ethiopia. The result agrees with the results of [11, 16]; who isolated *Klebsiella pneumoniae* and *E. coli* at a high rate from mobile and stethoscopes in intensive care units also with [17] who isolated coagulase negative *Staphylococci*, *Staphylococcus aureus*, *Micrococci*, *Klebsiella* and *Enterobacter aerogenes* from mobile phones and most of these bacteria are harmful and may be associated with harmful hygienic events [8].

### 3.1. Antibiotic Sensitivity test:

The result of the present study (Table 3) showed that Ciprofloxacin was effective against all the isolates gram-positive and gram – negative isolates, followed by amikacin which showed sensitivity on *Staphylococcus aureus* while it was resistant against most of the coagulase Negative *Staphylococci* and all the gram- negative bacteria, Gentamicine showed good antimicrobial effects on

*Staphylococcus aureus*, *E. coli* and *Acinetobacter lowffii*.

*Staphylococcus aureus* showed good sensitivity against Azithromycin, and all the coagulase negative *Staphylococci* except *Staphylococcus epidermidis* and *Staphylococcus saprophyticus*, *Kocuria rosea* was also resistant to this antibiotic and all Gram-negative isolates were sensitive to it except *Pseudomonas fluorescens*. Vancomycin was moderately effective against *Staphylococcus aureus* and *Staphylococcus cohnii* only. Trimethoprim was effective only against *E. coli*. the rest of the antibiotics including Cefotaxime, Bacitracin, Vancomycin and Trimethoprim showed no antibacterial effect against all the gram-negative bacteria and most of the antibiotics were ineffective against most of the coagulase negative *Staphylococci*. The study of [12] indicates the prevalence of multidrug resistance and the multidrug resistance bacteria was prevalent at 69.9% and about half of the gram – negative bacteria were resistant to Ampicillin and Trimethoprim which was consistent with our results as about 85% and 78.5% of the antibiotics showed resistant against all the isolates, Bacitracin showed resistance against all isolates, this result was consistent with the result of [18] who stated that most of the isolates were resistant to most of the used antibiotics. Ceftriaxone, Ciprofloxacin, and Gentamicin can be used for the treatment of infected patients with types of bacteria isolated from mobile phone in the study [12].

The result showed that Ciprofloxacin was the most effective among all the isolated gram-

positive and gram-negative bacteria while *Staphylococcus aureus* is the only sensitive to Amikacin among all the gram positive and negative isolates, all the isolates were resistant to Amoxicillin except *Acinetobacter lowffii* and only *Staphylococcus aureus* and *E. coli* showed sensitivity to Gentamycin, while all the remaining isolates were resistant.

All Gram – negative isolates except *E. coli* and all gram- positive except *Staphylococcus aureus* and *Staphylococcus capitis* were resistant to Trimethoprim all the isolates of gram negative and 60% of gram positive were resistant to Vancomycin and all of them also showed resistance to Cefotaxime except *E. coli* and only *Staphylococcus capitis* showed moderate sensitivity to Bacitracin, from these results it appeared that the isolates were multidrug- resistant , [12] reported the prevalence of multidrug- resistant bacteria at 69. 9% and they found that about half of gram- positive and gram- negative bacteria were resistant to Trimethoprim [6] indicated that mobile phones used for more than 24 months were found to be highly contaminated with MDR *Staphylococcus aureus* while Alkhlelawii reported that most of the isolates from mobile phones were sensitive to Trimethoprim, Levofloxacin and Tetracycline while they were resistant to Cephalexin, Amoxycillin, Clavulanic acid and Cloxacillin these studies confirm the prevalence of MDR strains on mobile phones which is a vehicle for transitions of disease. and Cloxacillin these mobile phones which makes them vehicles for transitions of disease.

**Table 3.** The inhibitory zone of antibiotics on isolated bacterial species.

Sample/ antibiotics	AK1 0	CN1 0	TMP 10	AMC 30	CIP1 0	VA3 0	B1 0	CTX3 0	AZM 15
1 <i>Staphylococcus aureus</i>	21	17	18	15	22.9	14	11	7	16
2 <i>Staphylococcus saprophyticus</i>	6	6	6	6	57	6	6	6	6
3 <i>Staphylococcus epidermidis</i>	15	25	6	6	35	20	6	6	6
4 <i>Staphylococcus haemolyticus</i>	14	12	6	9	27	6	7	8	6
5 <i>Staphylococcus hominis</i>	11	12		12	25	6	8	7	10
6 <i>Staphylococcus cohnii</i>	13	20	6	6	33	24	12	6	30
7 <i>Staphylococcus auricularis</i>	13	9	9	8	30	9	9	7	21
8 <i>Staphylococcus capitis</i>	11	14	34	6	26	22	16	32	25
9 <i>Acinetobacter haemolyticus</i>	9	9	7	8	25	8	7	8	24
10 <i>E. coli</i>	15	31	30	14	28	6	6	28	28
11 <i>Micrococcus leuteus</i>	12	14	8	6	28	8	8	8	20
12 <i>Kocuria rosea</i>	9	12	9	8	22	8	8	11	9
13 <i>Acinetobacter lowffii</i>	11	24	15	34	42	14	6	16	21
14 <i>Pseudomonas fluorescens</i>	10	9	8	9	23	8	9	10	10

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