



The Role of Mobile Phones in the Transmission of Methicillin-Resistant *Staphylococcus aureus* (MRSA) among the Students and Staff of the College of Health and Medical Technology/ Kufa in Najaf, Iraq

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Abstract

Background: During every phone call the mobile phone, come into close contact with strongly contaminated human body areas with hands to hands, and hands to other areas like mouth, nose, and ears [10]. Mobile phones touch faces, ears, lips, and hands of different users thus they may be serves as reservoirs of different pathogens [11]. This study was designed to determine the role of the mobile phones in the transmission of methicillin-resistance *Staph. aureus*. Methodology: The cross-sectional study was done in the college of health and medical technology/ Kufa- Najaf- Iraq. Three hundred swab samples from mobile phones were collected from the students and staff of the college from November- 2015- February-2016 and divided into three groups categorized according to the site of collection (from the mobile phones) as follows: earpiece, keypad or touch screen, and mouthpiece. All samples were cultured, and the resulting isolates were identified and subjected to antimicrobial susceptibility test by standard procedures (Kirby-Bauer method).Methicillin-resistant *Staph. aureus* was detected by using polymerase chain reaction (PCR) based on *mecA* gene. Results: Keypad or touch screen was occupied the highest percentage (58.74%) of bacterial contamination among other regions i. e. earpiece (26.7%) and mouthpiece (14.83%).Coagulase-negative *Staph. aureus* was predominant (41.83%) bacterial genus among other Gram-positive genera. Other Gram-positive bacteria had different ratios; there were 28.37%, 19.71%, 8.65%, 0.96% and 0.048 for *Micrococcus* spp., *Bacillus* spp. Methicillin-sensitive *Staph. aureus* (MSSA), Methicillin-resistant *Staph. aureus* (MRSA), and *Enterococcus faecalis*, respectively. On the other hand, Gram-negative bacteria gave different percentages, ranging from 53.57% for *E. coli* to 3.57% for *Salmonella* spp. Molecular detection was revealed the presence of *mecA* gene in only two isolates of *Staph. aureus*. Conclusion: Mobile phones may serve as vehicles of transmission of methicillin-resistance *Staph. aureus*.

Keywords: Mobile phones, Methicillin Resistant *Staph. aureus*, Meca gene.

Introduction

Microbiological standards in hygiene are necessary for a healthy life. It is common, however, to observe practices that deviate from normal standards of hygiene in both the developing and developed world [1]. Source of infection may be exogenous such as air, medical equipment, and hands or endogenous such as skin flora [2]. Certain microbial species colonize the skin surface and approximately 2m² of adult human skin

covered 10¹² bacteria [3]. The normal microflora of the skin includes coagulase-negative *Staphylococci*, *Diphtheroids*, *Streptococci*, *Bacillus* spp., *Mallassesia furfur* and *Candida* spp. Other microorganisms include *Mycobacterium* spp. (occasionally), *Pseudomonads* and, *Enterobactenaceae* occasionally [4]; they were harmless and may be beneficial in their normal location in the host. On the other hand, in the absence of

coincident abnormalities, they are capable of producing a disease condition if introduced into foreign locations or in the case of immune-compromised or immune-deficient hosts [5]. Healthcare-associated infections increase day-by-day and such infection causes significant rate of mortality and morbidity [6]. The global system for mobile telecommunication (GSM) was established in 1982 in Europe with a view to providing and improving communication network.

Today, mobile phones have become one of the most indispensable accessories of professional and social life. In addition the standard voice function of a telephone, mobile phones can support many additional services such as SMS for text messaging, email, packet switching for access to the Internet, and MMS for sending and receiving photos and video. With all the achievements and benefits of the mobile phone, it is easy to overlook the health hazard it might pose to its many users. The constant handling of the mobile phones by users makes it an open breeding place for the transmission of microorganisms.

This is especially so with those associated with the skin due to the moisture and optimum temperature of human body especially our palm [7]. Mobile phones continue to have an increasing presence in almost every aspect of our occupational, recreational, and residential environments. In the higher school, university environment, teachers, and students have indicated that 100% have access to computers and mobile phones [8].

It has become a necessity of everyday life, and an indispensable attribute of the modern society [9]. During every phone call the mobile phone, come into close contact with strongly contaminated human body areas with hands to hands, and hands to other areas like mouth, nose, and ears [10]. Mobile phones have become veritable reservoirs of pathogens as they touch faces, ears, lips and hands of different users [11]. This study was designed to determine the role of the mobile phone in the transmission of methicillin-resistance *Staph. aureus*.

Materials and Methods

Samples Collection and Processing

Three hundred specimens from 100 mobile phones were randomly collected (three

specimens from each mobile phone) from the students and staff of the college of health and medical technology/ Kufa. Sterile normal saline moistened swabs were used to collect the samples aseptically (inside the laminar flow cabinet) from the earpiece, keypad or touchscreen and, mouthpieces. They were streaked directly on culture media (Culture media were prepared according to manufacturer's companies; they were MacConkey's agar, blood agar, mannitol salt agar). The inoculated media were incubated at 37°C for 24 hours under aerobic condition.

Diagnosis of Isolates

Purified colonies were diagnosed according to Bailey and Scott's diagnostic microbiology [12], and then they were sent to central health laboratory in Al-Najaf for further identification by the Vitek-2 system.

Antimicrobial Susceptibility

Antimicrobial susceptibility patterns were done according to Kirby-Bauer technique (1966) [13].

PCR Primer and Condition

MecA gene (Methicillin resistance gene) was detected by using PCR method. The primer used for detection of the *mecA* gene was MecA1 (5'-GTA GAA ATG ACT GAA CGT CCG ATAA) and MecA2 (5'-CCA ATT CCA CAT TGT TTC GGT CTA A), yielding a 310-bp amplicon. The PCR cycling condition: The denaturation step at 94°C for 4 min. 30 cycles. Forty-five seconds at 94°C, 45 s at 50°C, and 60 s at 72°C. Final extension step at 72°C for 2 min. Ten-microliter aliquots were loaded onto agarose gel electrophoresis (1% agarose, 1× Tris-buffered EDTA; 90 V for 90 min) and stained with 10 µg/ml of ethidium bromide after electrophoresis [14].

Statistical Analysis

Statistical analysis achieved by using Statistical Package for the Social Sciences (SPSS) version (20).

Results

The results of the present study were demonstrated that most mobile phones were found to be colonized by bacteria; others were colonized by some fungi as well as bacteria. These results illustrated that the high percentages of the isolated bacteria found in the region 2/keypad or touch screen in comparison with earpiece and mouthpiece

respectively. Bacterial isolation percentages were 58.47%, 26.7 and 14.83% for Keypad or touchscreen, Earpiece, and mouthpiece

respectively, which were clearly shown in Figure (1).

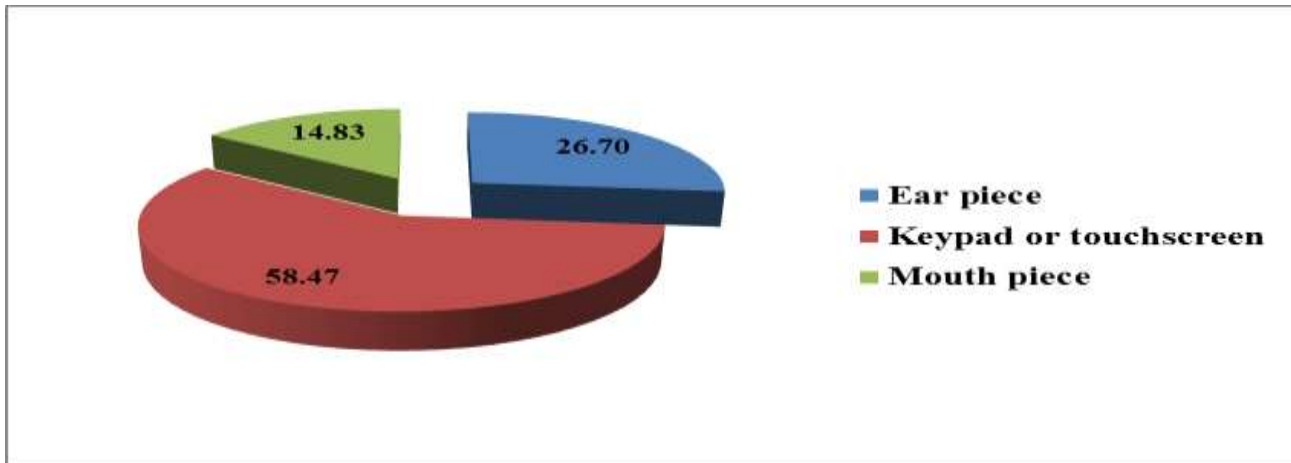


Figure 1: The percentages of bacterial isolation according to the region

The present study results in table one demonstrate that the coagulase negative Staphylococci were predominant (87 (41.83%)) (P-value= 0.002041) among other Gram-positive genera, while the lowest rate was one isolate (.048%) for *Enterococcus faecalis*. However, other Gram-positive genera indicate different percentages, there were 59 (28.37%), 41 (19.71%), 18 (8.65%) and 2 (0.96%) for *Micrococcus* spp., *Bacillus*

spp. Methicillin-sensitive *Staph. aureus* (MSSA) and Methicillin-resistant *Staph. aureus* (MRSA), respectively. To confirm the presence of MRSA, Polymerase Chain Reaction technique was used for this purpose (figure 2 and figure 3). On the other hand, the results showed that the keypad or touch screen is the most contaminated area with bacteria when compared with other regions i. e. ear and mouth piece (P-value= 0.011255).

Table 1: Percentages of isolation of Gram- Positive genera from different regions of mobile phones

Isolated Genera	Gram-positive genera							
	Earpiece		Keypad or touch screen		Mouthpiece		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Coagulase negative Staphylococci	27	12.98	47	22.60	13	6.25	87	41.83
<i>Micrococcus</i> spp.	13	6.25	30	14.42	16	7.69	59	28.37
<i>Bacillus</i> spp.	15	7.21	24	11.54	2	0.96	41	19.71
Methicillin sensitive <i>S. aureus</i>	3	1.44	14	6.73	1	0.48	18	8.65
Methicillin resistant <i>S. aureus</i> *	0	0.00	2	0.96	0	0.00	2	0.96
<i>Enterococcus faecalis</i>	0	0.00	1	0.48	0	0.00	1	0.48
Total	58	27.88	118	56.73	32	15.38	208	100

* See figure (3)

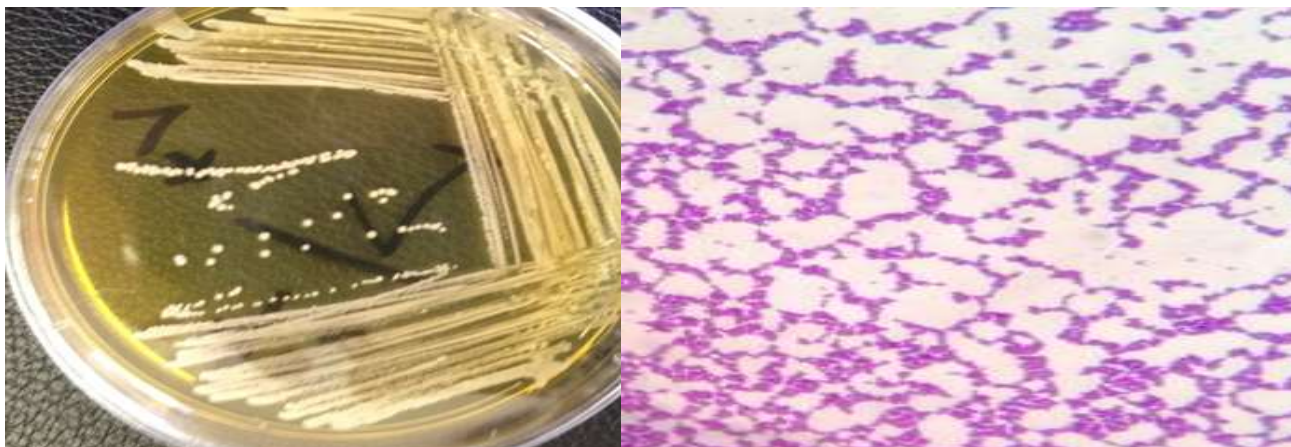


Figure 2: *Staph. aureus* colonies on mannitol salt agar after 24 hrs. of incubation at 37°C under aerobic condition. B: *Staph. Aureus* smear, stained with gram stain under 100x

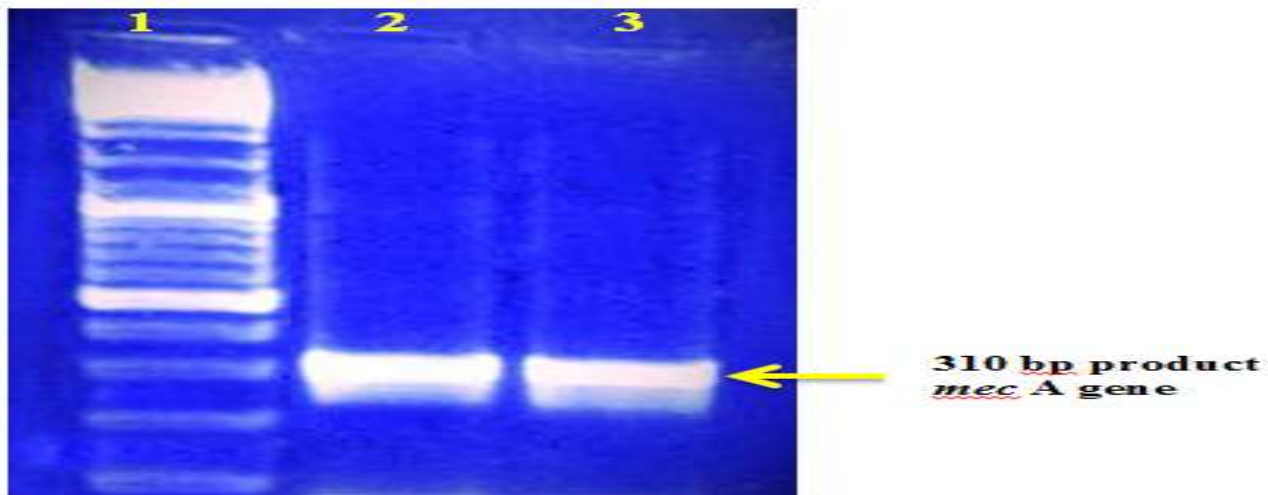


Figure 3: Polymerase chain reaction amplification products of *mec A* gene of methicillin resistance *Staph. Aureus* “310-bp” (Lane 1= 100 bp ladder marker, Lane 2, 3 positive results of *mec A* gene)

Gram-negative bacteria were isolated from different regions in the present study; the results in table two showed that the bacterium *E. coli* occupied the highest proportion (15 (53.57%)) of isolation

percentages while the bacteria *Citrobacter* sp. and *Salmonella* sp. recorded lower percentages (1(3.57%) for both genera respectively (P- value =0.084988).

Table 2: Percentages of isolation of Gram- negative genera from different regions of mobile phones

Isolated Genera	Gram-negative genera							
	Ear piece		Keypad or touch screen		Mouth piece		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
<i>E. coli</i>	2	7.14	11	39.29	2	7.14	15	53.57
<i>Klebsiella spp.</i>	2	7.14	5	17.86	1	3.57	8	28.57
<i>Pseudomonas spp.</i>	1	3.57	2	7.14	0	0.00	3	10.71
<i>Citrobacter sp.</i>	0	0.00	1	3.57	0	0.00	1	3.57
<i>Salmonella spp.</i>	0	0.00	1	3.57	0	0.00	1	3.57
Total	5	17.86	20	71.43	3	10.71	28	100

Discussion

The possibility transmissions of nosocomial pathogens by electronic devices such as personal digital assistants, handheld computers, and bedside applications were previously reported and some of them were epidemiologically important drug-resistant pathogens [15].The results, unfortunately, revealed that the highest percentage of contamination in touch screen area.

As it is a real danger for the transfer of germs from person to person, especially children, who represent the mobile phones as a new model of play; thus the user must be careful in the handling and using their mobile phones. Mobile phones could become veritable reservoirs of pathogens that could result in infections due to their personal nature and proximity to a sensitive part of our bodies in usage such as faces, ears, lips and hands of users [16]. Previously, different studies suggest that mobiles can act as reservoir and source of infection; similarly, other authors pointed out mobiles as vectors for the transmission of potential pathogens,

and found from 60 mobile phones, *Staph. aureus* was found in 39.5% of all the isolation these reports confirm the fact of pathogenic microorganisms, occurrence, the golden staphylococcus genus recovered in the present studies from the mobile surface[17]. Singh et al.,[18] Borer et al., [19] Goldglatt et al., [20] Karabay et al., [21] Jayalakshmi et al., [22] and Sham et al., [23] all these researchers demonstrated that an average cell phone carries more germs than a public toilet seat [24].

The percentages of pathogenic bacteria isolated from the mobile phones differ from one research to another; that may be due to the poor hygienic and sanitary practices associated with the low level of education or the duration of uses mobile phones or due to the lifestyle. Singh et al [25]. Reported that over 47% of immobile phones were contaminated with pathogenic microbes .The study of Ulger et al. 2009^[15] showed that 94.5% investigated cell phones owned by healthcare workers were contaminated with

a various type of bacteria, and *Staph. aureus* was found in 39.5% of all the isolates.

While Gram-negative strains were 31.3%.It was worth mentioning that the touch-screen is the most contaminated area with both Gram-positive and Gram-negative bacteria. The contamination of mobile phones among the student's points to the need to promote such information among the students enrolled in the classes to do some personal hygiene, especially hand hygiene, which denotes the most important procedure to prevent the transmission of human

pathogenic and opportunistic bacteria [26]. In conclusions, the mobile phones act as a reservoir of microorganisms that can be transmitted various types including MRSA. Thus further studies must be done to find an appropriate method for cleaning of mobile phones with disinfectant or hand cleaning detergents which should be curtailing any potential disease transmission.

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