

# Microbial contamination of cellular mobile devices used by medical staff and healthcare workers (HCWs) in Al-Yarmouk Teaching Hospital, Baghdad, Iraq

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## Abstract

**Background:** Mobile phones are widely used non-medical portable electronic devices. The uses of mobile phones occur in hospital wards, Consultation clinic, laboratories, and pharmaceutical warehouse and also in operation rooms. Over the past decade, mobile phones have become an essential accessory in our social and professional life. The mobile phones of health care workers harbor many harmful pathogens which serve as a reservoir for nosocomial infections.

**Aims:** We aimed to investigate Microbial contamination for cellular mobile devices used by medical staff and healthcare workers in Al-Yarmouk Teaching Hospital, Baghdad, and detection of microbes that cause these contaminations, whether bacterial, fungal or parasitic.

**Materials and Methods:** Samples were collected from mobile devices of 16 physicians, 23 residents, 18 interns, 10 pharmacists and 35 nurses. Three sterile swabs moistened with sterile saline and each was rotated over the surface of both sides of the mobile phones.

**Results:** Out of 102 mobile samples of medical staff in Al-Yarmouk Teaching Hospital evaluated, growth was observed in 80 samples (78.4%) and the remaining 22 (21.6%) were sterile. Eight species of Bacteria were isolated, 35(34.3%) Staphylococcus epidermidis, 29 (28.4%) Staphylococcus aureus, 13(12.7%) Escherichia coli, 8(7.8%) Klebsiella spp, 7(6.9%) Streptococcus pyogenase, 6 (5.9%) Proteus mirabilis, 4 (3.9%) Bacillus spp and 3 (2.9%) Pseudomonas aeruginosa. There were fungal isolates as follows: 6 (5.88%) Candida spp, 4 (3.92%) Aspergillus spp, 3 (2.9%) Mucor spp, based on mycelia, color and spores. Eggs & cysts of parasite haven't seen under microscope. The highest rates of single growth was 13 (12.7%) reported among Resident, while the higher percentage of single growth recorded in General Surgery department. There were statistical relations between microbial growth and gender, profession and department of healthcare workers.

**Conclusions:** The current study showed that 78% of 102 samples taken from mobiles of medical staff in Al-Yarmouk Teaching Hospital in Baghdad city, were contaminated by several microbes, most of which belonged to the natural flora of the human body as well as airborne fungi and soil. So it is necessary to sterilize your hands after contact with cell phones as an important source for the transfer of these microbes.

**Keywords:** Microbial contamination, cellular mobile, medical staff

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## INTRODUCTION

Nosocomial infection is an important problem in all modern hospitals. The hands of physician and healthcare workers (HCWs) play an important role in transmission of this infection. Previous studies showed the role of hospital environmental surfaces, work place, small medical devices like thermometers, stethoscopes, in transmission of bacteria.<sup>[1, 2]</sup> Nowadays, mobile phones are widely used non-medical portable electronic devices. The uses of mobile phones occur in hospital wards, Consultation clinic, laboratories, and pharmaceutical warehouse and also in operation rooms. Over the past decade, mobile phones have become an essential accessory in our social and professional life. The mobile phones of health care workers harbour many harmful pathogens which serve as a reservoir for nosocomial infections.<sup>[3]</sup> Handling of the phone by different users exposes it to an array of microorganisms and makes it a good carrier for microbes especially those associated with the skin resulting in the spread of different microorganisms, from user to user.<sup>[4]</sup> Microbiologists say that the combination of constant handling with the heat generated by the phones creates a prime breeding ground for many microorganisms that are normally found on the skin, Staphylococci; particularly Staphylococcus epidermidis are members of the normal flora of the human skin, respiratory and gastrointestinal tracts.<sup>[4]</sup> Nasal carriage of S aureus occurs in 20-25% of human beings.<sup>[5]</sup> Staphylococci are also found regularly on clothes, bed linen, and other human environments.<sup>[5]</sup> Staphylococcus aureus a common bacterium found on the skin and in the noses of up to 25% of healthy people and animals can cause illnesses from pimples and boils to pneumonia and meningitis, and is a close relative of methicillin resistance Staphylococcus aureus.<sup>[6]</sup> The main reservoir of S aureus is the hand from where it is introduced into food during preparation.<sup>[6]</sup> The hand serves as a major vehicle of transmission of various microbes including the enteric species.<sup>[7]</sup> The role of mobile phones in spread of bacteria is not clear. Therefore, this study was conducted to determine microbial contamination of cellular mobile devices used by medical staff and healthcare workers in Al-Yarmouk Teaching Hospital, Baghdad, Iraq, and identify the most important microbial species associated with these phones in order to take the necessary decontamination measures.

## PATIENTS AND METHODS

One hundred and two samples swab were collected from mobile devices belong to physicians and health workers

(HCWs) of Al-Yarmouk Teaching Hospital, of departments of General Surgery, Orthopedic Surgery, Obstetrics and Gynecology, Consultation clinic, Internal Medicine and pharmaceutical warehouse during a three week period from June 20, 2012 to July 11, 2012. Samples were collected from mobile devices of 16 physicians, 23 residents, 18 interns, 10 Pharmacist and 35 nurses. Three sterile swabs moistened with sterile saline and each was rotated over the surface of both sides of the mobile phones. Swabs were streaked into three plates that consist of 5% blood agar, MacConkey agar and nutrient agar. The inoculated plates were incubated at 37°C for 48 hours. The isolated microorganisms were identified using Gram's stain and further subjected to biochemical analysis.<sup>[8, 9]</sup> The second sample of each mobile phone swab was streaked onto plate containing Sabouraud's dextrose agar with chloramphenicol (0.05 mg/ml). The plates were incubated at 25°C. The cultures were examined every 2-4 day for evidence of growth. The fungi were identified by colonial morphology and microscopic examination. A drop of 95% Ethanol was placed on microscope slide. Sterile needle was used to gently remove a portion of fungal growth. When most of the ethanol has evaporated, A drop of lacto phenol cotton blue stain were added and covered with a cover slip and examined microscopically.<sup>[10, 11]</sup> Third sample of each mobile swab moistened with sterile normal saline and immediately examine by direct smear examination to detect cysts or eggs of parasite if present.<sup>[12]</sup>

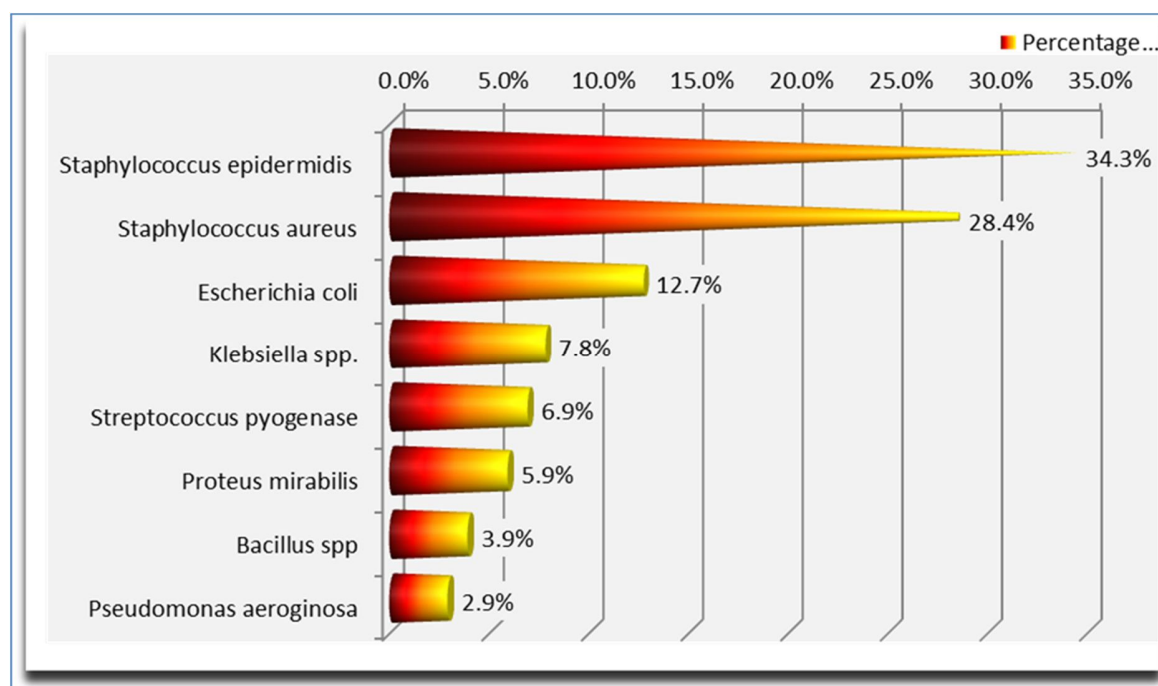
## RESULTS

Out of 102 mobile samples of medical staff in Al-Yarmouk Teaching Hospital evaluated, growth was observed in 80 samples (78.4%) and the remaining 22 (21.6%) were sterile. Eight bacterial isolates were detected including, 35(34.3%) Staphylococcus epidermidis, 29(28.4%) Staphylococcus aureus, 13(12.7%) Escherichia coli, 8(7.8%) Klebsiella spp, 7(6.9%) Streptococcus pyogenase, 6(5.9%) Proteus mirabilis, 4(3.9%) Bacillus spp and 3(2.9%) Pseudomonas aeruginosa as shown in [Figure 1]. There were fungal isolates as follows: 6 (5.88%) Candida spp, 4 (3.92%) Aspergillus spp, 3 (2.9%) Mucor spp, based on mycelia, color and spores. Eggs & cysts of parasite haven't seen under microscope [Figure 2]. Table (1) illustrated the microbial growth isolated from mobile devices and age of participants, medical staff subdivided according to age into six age groups. The higher percentage of single growth was 22.5% reported among 30-34 age, while the lower percentage was 2% reported

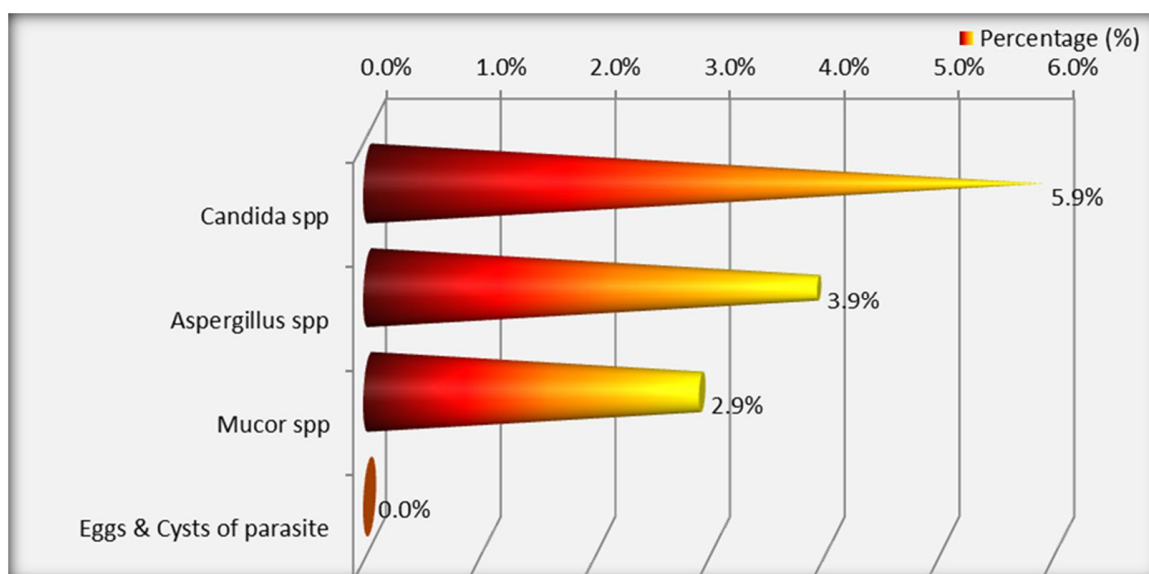
among 40-44 years old. There were insignificant differences between the microbial growth and age.

**Table 1.** Microbial growth isolated from mobile devices used by medical staff to Al-Yarmouk Teaching Hospital, depending on the Age

Age groups	Growth						Total	
	Single microbes		Multiple microbes		Sterile			
	No.	%	No.	%	No.	%	No.	%
<25	4	3.9	3	2.9	2	2.0	9	8.8
25-29	10	9.8	12	11.8	8	7.8	30	29.4
30-34	23	22.5	9	8.8	6	5.9	38	37.3
35-39	4	3.9	4	3.9	0	0	8	7.8
40-44	2	2.0	3	2.9	5	4.9	10	9.8
≥45	4	3.9	2	2.0	1	1.0	7	6.9
<b>Total</b>	47	46.1	33	32.4	22	21.6	102	100
<b>P value</b>	0.207							



**Figure 1.** Contaminated cellular mobile devices with different bacterial isolates.



**Figure 2.** Fungi isolated from cellular mobile devices used by medical staff in the Al-Yarmouk Teaching Hospital

Table (2) shows the percentage of growth according to gender, Single growth for males was 29(28.4%) and for females 18(17.6%). Table (3) shows significant relations for the microbial growth in the medical staff and the profession of participants, the higher percentage of single growth was 13(12.7%) reported among Resident and the lower percentage reported in Pharmacist and physician. Table (4) shows the relationship between the growths and the department of healthcare workers, the higher percentage of single growth was (10.8%) reported in General Surgery department followed by Consultation clinic (9.8%), Obstetrics and Gynecology (8.8%), Internal Medicine (6.9%), Orthopedic surgery (5.9%) and Pharmaceutical warehouse (3.9%).

**Table 2.** Microbial growth isolated from mobile devices used by medical staff to Al-Yarmouk Teaching Hospital, depending on the gender

Gender	Growth No. (Percentage %)			Total
	Single microbes	Multiple microbes	Sterile	
male	29 (28.4)	10 (9.8)	4 (3.9)	43 (42.2%)
female	18 (17.6)	23 (22.5)	18 (17.6)	59 (57.8%)
<b>Total</b>	47 (46.1)	33 (32.4)	22 (21.6)	102 (100%)
<b>P value</b>	0.001*			

\*Significant using Pearson Chi-square test at 0.05 level of significance.

**Table 3.** Microbial growth isolated from mobile devices used by medical staff to Al-Yarmouk Teaching Hospital, depending on the profession

profession	Growth number (percentage %)			Total
	Single microbes	Multiple microbes	Sterile	
<b>Interns</b>	10 (9.8)	7 (6.9)	1 (1.0)	18 (17.6%)
<b>Nurses</b>	12 (11.8)	11 (10.8)	12 (11.8)	35 (34.3%)
<b>Pharmacist</b>	6 (5.9)	4 (3.9)	0 (.0)	10 (9.8%)
<b>Physician</b>	6 (5.9)	3 (2.9)	7 (6.9)	16 (15.7%)
<b>Resident</b>	13 (12.7)	8 (7.8)	2 (2.0)	23 (22.5%)
<b>Total</b>	47 (46.1)	33 (32.4)	22 (21.6)	102 (100%)
<b>P value</b>	0.038*			

\*Significant using Pearson Chi-square test at 0.05 level of significance.

**Table 4.** Relationship between the growths of microbes isolated from mobile devices of medical staff to Al-Yarmouk hospital depending on their departments

Department	Growth number (percentage %)			Total
	Single microbes	Multiple microbes	Sterile	
Obstetrics and Gynecology	9 (8.8)	15 (14.7)	12 (11.8)	36 (35.3%)
General Surgery	11 (10.8)	4 (3.9)	3 (2.9)	18 (17.6%)
Consultation clinic	10 (9.8)	2 (2.0)	6 (5.9)	18 (17.6%)
Internal Medicine	7 (6.9)	6 (5.9)	0 (0)	13 (12.7%)
Orthopedic surgery	6 (5.9)	3 (2.9)	1 (1.0)	10 (9.8%)
Pharmaceutical warehouse	4 (3.9)	3 (2.9)	0 (0)	7 (6.9%)
<b>Total</b>	47 (46.1)	33 (32.4)	22 (21.6)	102 (100%)
<b>P value</b>	0.038*			

\*Significant using Pearson Chi-square test at 0.05 level of significance.

## DISCUSSION

In this study, the use of mobile phones by medical staff working in Al-Yarmouk Teaching Hospital not only demonstrated a high contamination rate with bacteria but also more importantly contamination with nosocomial pathogens. 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.<sup>[13, 14]</sup> Isaacs et al.<sup>[13]</sup> showed that the main growth was of coagulase-negative staphylococci from 25 keyboards. Two keyboards grew *Staphylococcus aureus*, both of which samples were susceptible to methicillin /flucloxacillin. Rusin et al.<sup>[15]</sup> documented hand-to-mouth transfer of microbes after handling contaminated fomites during casual activities. Singh et al.<sup>[16]</sup> reported that over 47% of immobile phones were contaminated with pathogenic microbes. These results suggested that close contact objects that were contaminated could serve as reservoirs of bacteria where could be easily transmitted from the mobile phone to the healthcare worker's hands. During every phone call the mobile phones come into close contact with strongly contaminated human body areas with hands to hands and hands to other areas (mouth, nose, ears). Here in mobile phones are particularly problematic when compared to immobile devices and it may facilitate transmission of bacterial isolates from patient to patient in wards or hospitals. Some authors<sup>[17-19]</sup> showed that healthcare workers mobile phones were contaminated with nosocomial pathogens. The result of our study demonstrated cross

transmission of bacteria between medical staff dominant hands and mobile phones. Gram negative bacteria are very important nosocomial pathogens and medical staff mobile phones were carried Gram negative isolates. Gram-negative sepsis is most commonly caused by *E coli*, *Klebsiella spp*, and *Pseudomonas aeruginosa*. Karabay et al.<sup>[18]</sup> reported that mobile phones may get contaminated with such bacteria as *Escherichia coli*, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*, which cause hospital infections, and may serve as a vehicle for the spread of nosocomial pathogens. Users of mobile phones are found everywhere: in the market, the home, hospitals, and schools. They could therefore, be the cause of the spread of the infection in the community. *Bacillus subtilis* has been identified as an important organism in food spoilage.<sup>[20]</sup> This undoubtedly contributes a great deal to food spoilage and the contamination of food if food is prepared or eaten with infected hands. These isolates can significantly influence food spoilage and food infection through the production of toxins. There were fungal isolates as follows: *Aspergillus spp*, *Mucor spp* and *Candida spp*, these organisms may probably have found their entry to the mobile phone from skin as in the case of *Candida spp* this is because most of the isolated fungi are inhabitants of soil and air.<sup>[19, 20]</sup> *Candida spp* and *Aspergillus spp* can be pathogenic causing infection like *Aspergillosis* and *candidiasis*.<sup>[19, 21]</sup> *Mucor* add significantly to food spoilage and food infection through the production to toxins.<sup>[4]</sup> Borer et al.<sup>[17]</sup> observed that there were contaminations of hands and mobile phones only in 10% of their staff who were sampled for once. In this study contamination rate of medical staff mobile phones was

78.4%. The higher percentage of single growth was (10.8%) reported in General Surgery department may be due to close contact of surgeon and patients. Jeske et al.<sup>[22]</sup> also reported that bacterial contamination of anesthetists' hands by personal mobile phones occurred in the operating room. The use of mobile phones by medical staff in General Surgery department, Obstetrics & Gynecology and orthopedic surgery department may have more serious hygiene consequences, because unlike fixed phones, mobile phones are often used close to patients. The higher percentage of single growth was 12.7% reported among Resident may due to close contact of resident and patients. Eggs & cysts of parasite haven't seen under microscope may be due to Limited number of samples taken from mobile or the fact that all participants in the research are health workers did not laboratories which closely contact with stool samples of patient during a routine examination. According to these results it is obvious that, the training of healthcare personnel about strict infection control procedure, hand hygiene, environmental disinfection, and eventually, optimum disinfection methods are of great importance. Developing active preventive strategies like routine disinfection of mobile phones with alcohol containing disinfectant materials might reduce contamination. Another way of reducing microbial contaminations on mobile phones might be the use of antimicrobial additive materials.

**Conclusions:** The current study showed that 78.4% of 102 samples taken from mobiles of medical staff in Al-Yarmouk Teaching Hospital in Baghdad city, were contaminated by several microbes, most of which belonged to the natural flora of the human body as well as airborne fungi and soil. That it was necessary to sterilize your hands after contact with cell phones as an important source for the transfer of these microbes.

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