

## ARTICLE

# STUDYING THE LEVEL OF MICROBIAL INFECTION OF MOBILE PHONES AMONG NURSES WORKING IN THE INTENSIVE CARE UNITS OF HOSPITALS

Mohammad Darvishi<sup>1</sup>, Mohammad Reza Nazer<sup>2\*</sup>

<sup>1</sup>Infectious Diseases and Tropical Medicine Research Center (IDTMRC), AJA University of Medical Sciences, Tehran, IRAN

<sup>2</sup>Department of Infectious Diseases, Hepatitis Research Center, Lorestan University of Medical Sciences, Khorramabad, IRAN

## ABSTRACT



**Background:** The problem of hospital infections is a great common problem in all hospitals and health centers. As using mobile phones becomes more and more common among all people including the health workers, there is a growing concern that this tool can act as a source to distribute hospital microorganisms throughout the society. The present research aims to study the level of microbial infection observed in the mobile phones of nurses working in the ICU of Besat Hospital in Tehran, Iran in February of 2016. **Method:** In this study 25 nurses working in the ICU of Besat Hospital were chosen by random selection. Demographic information, attitudes, awareness, type of mobile phone, and frequency of cleaning the cellphone per a day were collected in certain questionnaires. In order to assess the microbial infection of mobile phones, wet sterile swabs were used for sampling and the process of cultivation was carried out in the medium containing nutrients. **Results:** In this study about 65.3% of the mobile phones devices has been found infected. The following bacteria were observed: *Staphylococcus epidermidis* (26.7%), *Staphylococcus aureus* (20%), *Non-albicans candida* (16.7%), *Bacillus SP* (13.3%), *Micrococcus SP* (10%), *Non-hemolytic streptococcus* and *Enterococcus* (6.7% each) and *Acinetobacter* and *Klebsiella* (3.3% each). **Conclusion:** Mobile phones can act as the potential transporters of hospital infections and the level of infection is significantly higher in smart phones (than non-smart ones) owned by males (compared to their female peers). Thus, limiting the use of cellphone devices is an option which can be considered in the ICU of hospitals. Keeping in mind the significant influence of cleaning these phones in reducing the bacterial infections, regular dis-infection of cellphones and observing the principles of hygiene in hospitals is a crucial point.

## INTRODUCTION

Hospital infections are increasing every day and it may result in a higher death rate. As many as 25% of the patients hospitalized in the hospitals in developed countries experience this issue [1]. For US hospitals, an annual rate of 1.7 million cases of patients with hospital infections are reported while 100 thousand of them will pass away [2]. The infectious agents of hospital infections may spread through hands of hospital personnel, thermometers, stethoscopes, and even the toys used in the pediatric intensive care unit in the whole hospital [1].

The first global determination to use mobile phones to establish better communication was made in Europe in 1982. Nowadays, mobile phones have become into a necessary tool for social and professional life. Although they may be kept in pockets or purses, they are often held in the hand of users and are in direct contact with their faces [3]. Now days mobile phones may be used everywhere including dinner tables, kitchens, restaurants, clubs, and even bath rooms. These factors and the heat generated by these phones results in the significant growth of bacteria on the surface of the devices [2].

Using mobile phone is often observed in hospital halls, labs or ICU where patients with serious problems are kept [1]. Widespread use of mobile phones among the medical staff of hospitals is a contradiction. The major question here is how we can use mobile phones and reduce its harms. For example in cases of emergency, surgeons can use their mobile phones to consult with their professors or colleagues and ask technicians for help when proper function of operation room devices has fail but these mobile phones, may cause infections in patients [4].

In a research conducted by Ulger et al (2009), as many as 94.5% of mobile phones were infected with various types of bacteria. 31.3% of these phones were infected with gram negative bacteria and 39.5% of the bacteria observed in the hands of their users were resistant against Cefotaxime. Also 52% of the mobile phones were infected with *Staphylococcus aureus* and the hands of the users in this group were also resistant against Methicillin (MRSA) in 37.7% of the cases. Re-researches have found similar microbes on the people's hands and cellphones [4]. Another research conducted by Badr et al (2012) showed that hand contamination of hospital staff following using mobile phones had increased 93.7% [3]. In another research conducted by Singh et al (2012) no microorganisms had developed in the second cultivation obtained from mobile phones after they had been cleaned using an alcoholic pad [2].

Concerning the importance of hospital staff awareness of pathogens and observing the rules of hygiene and due to lack of a comprehensive research on the potential role of mobile phones in spreading pathogens in our country, the present research aims to study the infection level of mobile phones used by

## KEY WORDS

Mobile Phones, Nurses, ICU, Microbial Infections, Hospital Infections.

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## \*Corresponding Author

Email:  
dr\_nazer1@yahoo.com  
Tel.: 00986633236405

nurses working in ICU and their role in spreading bacterial infection in Besat Hospital of Tehran in February of 2016.

## MATERIALS AND METHODS

In this cross-sectional, descriptive-analytical research that carried out in 2016. The nurses working in the ICU of Besat Hospital of Tehran in February of 2016 has been considered as research population. Considering the formula used to calculate the sample volume for descriptive researches and keeping in mind the initial error level of our research (0.05), 0.95 possibility of mobile phones bacterial contamination (according to the previous researches [3]) and accuracy of researches set to a 10% possibility of mobile phones bacterial infections, at least 20 people were needed for the research. This number was further increased to 25 through convenient sampling method in order to enhance the accuracy.

Demographic information, attitudes, awareness, type of mobile phone, and frequency of cleaning the cellphone per day were collected in certain questionnaires. Samples were taken from mobile phones of nurses using sterilized swab. Another sample was taken from the phones after they had been cleaned with alcohol swabs. Sterilized swabs, test tubes containing nutrient broth medium, plates containing containing blood agar medium, and Macconkey agar were used for sampling. Sterilized swab was drenched in the tube containing liquid medium. After these swabs were drenched with the liquid inside the test tube, they were removed and contacted with a specific area of mobile phones (5 square cm) and then put inside the test tube containing nutrient broth medium. Then the test tubes were incubated for 24 hours with a temperature of 37 °C in lab. Using swabs, the contents of these test tubes were inoculated to solid medium plates (Macconkey and blood agar). After 24 hours, the number of colonies on mediums was determined, states of being gram positive or negative and accurate diagnosis of type and species were examined. It is clear that controlled experiments of media and sampling the surfaces were carried out simultaneously following dis-infection.

Chi-square and Fisher's exact test were used to determine the correlation between qualitative variables, while T test was used to compare the averages between the two groups. The level of significance was set to 0.05 in all cases.

## RESULTS

The results of this research are presented in [Table 1]. The average age of the nurses participating in this research was  $32.1 \pm 2.7$  years. Also 32% of the participants were male while and 68% were female and 72% of the nurses owned smart phones while 28% used non-smart phones (cellphones with no smart operating system). All nurses were aware of the possibility of transporting microbial agents through mobile phones and also of removing risk factors by cleaning the mobile phone, so. 60% of the nurses used to clean their phones more than once a day, while 24% of them cleaned their mobile phones only once a day. And beside them 16% of them never cleaned their mobile phones. Comparing the male and female nurses in terms of the frequency of cleaning their mobile phones every day showed that the frequency of cleaning among the female nurses was significantly more than what was observed among their male colleagues ( $P = 0.026$ ).

The frequency of microbial contamination in all mobile nurses' phones was 64% before cleaning, while this frequency was reduced to 8% following cleaning the phone and this difference was significant ( $P < 0.001$ ). The frequency of microbial contamination observed in the mobile phones owned by male nurses was significantly more than what was observed in female nurses (70.6% for males and 30.8% for females,  $P = 0.030$ ). A higher frequency of microbial contamination was observed in smart phones than what was observed non-smart ones (66.7% for smart phones and 22.2% for their non-smart counterparts,  $P = 0.046$ ).

**Table 1:** Results of the research

Variables	Frequency (percentage)	
Gender	Male	8 (32%)
	Female	17 (68%)
Type of phone	Smart	18 (72%)
	Non-smart	7 (28%)
State of awareness	Aware	30 (100%)
	Not aware	0 (0%)
Attitude	Favorable	30 (100%)
	Unfavorable	0 (0%)
How often they clean their phones every day	Never	4 (16%)
	Once	6 (24%)
	Twice	10 (40%)
	Thrice	5 (20%)
Microbial contamination	Positive	16 (46%)
	Negative	9 (36%)
	Staphylococcus epidermidis	8 (26.7%)

Microorganisms observed on the surface of mobile phones	Staphylococcus aureus	6 (20%)
	Non-albicans candida	5 (16.7%)
	Micrococcus SP	3 (10%)
	Non-hemolytic streptococci	2 (6.7%)
	Enterococcus	2 (6.7%)
	Klebsiella	1 (3.3%)

8 types of bacteria were found in the samples made from 25 cellphones before cleaning them: Staphylococcus epidermidis in 8 phones (26.7%), S. aureus in 6 phones (20%), non-albicans candida in 5 phones (16.7%), Bacillus SP in 4 phones (13.3%), Micrococcus SP in 3 phones (10%), non-hemolytic streptococcus and Enterococcus in 2 phones (6.7% each) and finally Acinetobacter and Klebsiella in 1 phone (3.3% each). It is necessary to say that the result of cultivation after cleaning the phones was positive in only 2 cases where Staphylococcus epidermidis and Micrococcus SP (each in only one phone) were observed. Both of these phones were contaminated with these microorganisms before cleaning.

## DISCUSSION

Hospital infection is a growing problem in many hospitals and health centers [5-7]. Hands, tools, mobile phones or other non-animate things in hospitals used by therapeutic staff can act as vectors transporting microorganisms in hospitals [2, 8-10]. Unlike stationary phones, mobile phones in these centers are used in the close proximity of patients who are vulnerable to infections [11, 12]. The present research seeks to study the frequency bacterial contamination in the mobile phones of nurses working in the ICU of Besat Hospital in February of 2016 in Tehran, Iran.

As many as 25 mobile phones belonging to 25 male and female nurses were studied in terms of their contamination with bacteria and the results indicated microbial contaminations in 16 cases (64%).

Studies conducted throughout the world are indicative of prevalence of microbial contaminations in the mobile phones of the therapeutic staff of hospitals. A research conducted by Karabay et al [1] in Turkey showed that as many as 91% of the mobile phones owned by therapeutic staff were contaminated by bacterial factors. In a study by Tagoe et al [13] in Ghana has been reported that 47% of the mobile phones owned by medical nurses are contaminated with bacteria. The research by Sepehri et al [14] in Kerman showed that 32% of the mobile phones of therapeutic staff were contaminated with bacteria.

As it is seen, the prevalence of microbial contamination in the mobile phones owned by therapeutic staff in some cases is more than what was observed in our research, while this frequency is less in some other cases.

Totally 8 types of bacteria were observed in the 25 mobile phones studied in this research. The most common one was S. epidermidis observed in 26.7% of cases (8 phones).

The prevalence of Staphylococcus in hospital infections throughout the world is on the rise and statistical analysis in most countries has shown S. epidermidis the most common cause of blood and urinary tract infections [15, 16].

The next prevalent microorganism was S. aureus observed in 6 cases (20%). Among the various species of Staphylococcus, S. aureus has been diagnosed as one of the most important pathogenic factors and one of the main causes of hospital infections [17]. The third microorganism observed on the mobile phones of nurses was Non-albicans candida observed in five phones (16.7%).

Although albicans candida as one of the most common causes of Candidiasis is very important that, recent epidemiological researches have proven that non-albicans candida will gradually replace albicans candida in causing the diseases [18-20]. The frequency of Candidaemia as a result of non-albicans candida among hospitalized patients has increased more than 500% compared to 1980s [2]).

Most species of this bacteria are associated by the diseases caused by foods which can result in severe or even lethal infections. Due to formation of endospore, these bacteria are resistant against to certain types of disinfectants and it is possible that they may survive even after disinfectant measures are taken [22].

In our research, Micrococcus was the fifth most common microorganism observed on nurses' cellphones (10%). This type of bacteria is observed everywhere such as in water, dust, and sand. It is the voluntary resident in natural skin flora and devices or equipment not properly cleaned and disinfected are where we can find it [23].

Non-hemolytic streptococcus and Enterococcus were observed in 2 mobile phones (6.7% each) owned by nurses studied in our research.

Non-hemolytic streptococcus is a kind of the bacteria in natural flora of human skin and it is one of the most frequent bacteria in the upper respiratory tract and conjunctiva of human eye and rarely causes any diseases for humans [24].

The least frequent microorganism observed on these mobile phones was Klebsiella observed on only 1 mobile phone (3.3% of cases).

Klebsiella species, particularly *K. pneumoniae*, are important members of Enterobacteriaceae family. They are considered to be opportunistic pathogens associated with acquired hospital infections such as neonatal infections, septicemia, pneumonia, urinary tract, and wound infections [25].

The following pathogens were observed on the surface of the mobile phones of therapeutic staff (doctors, nurses, residents and interns) in the research conducted by Karabay et al [1]: *E. coli* (40%), Enterococci, *E. faecalis* (20%), *Pseudomonas aeruginosa* (20%), *Pseudomonas fluorescens* (10%) and *Klebsiella pneumoniae* (10 %).

The following bacteria were found on the mobile phone of medical nurses in the study conducted by Tagoe et al [13]: 23% *Bacillus cereus*, 19% *P. mirabilis*, 3% *Salmonella*, and 2% *Shigella*. The most common pathogen observed on the mobile phones of workers in health centers in the study of Sepehri et al [14] was *S. epidermidis* (23% of all mobile phones). In the study carried out by Sridhar et al [26], the following values were found for each contamination in mobile phones: 46% with Micrococcus, 8% with coagulase-negative Streptococcus, 5% with *S. aureus*, 1% with *P. asturiensis*, 2% with *Acinetobacter baumannii*, 1% with *Citrobacter freundii*, 3% with *Klebsiella oxytoca*, 2% with non-albicans candida, 1% with trichosporonosis, and 1% with *Aspergillus niger*.

Considering the questionnaires completed by participants, all the participants agreed with this view that mobile phones can act as transporters of microbes particularly hospital bacteria and that cleaning your mobile phone can help reduce spread of microbial agents. However, 16% of the participants never used to clean their phones even once a day. This is less than the rate reported reported in previous researches. In the research conducted by Ghardashi et al [27], 94% of therapeutic staff (doctors, medical students, nurses, paramedics) believed that mobile phones can act as transporters of pathogens but 44% of them never used to clean their phones. Although all nurses knew they had to wash their hands after routine activities in Morioka et al.'s research [28], 36% of them never washed their hands after using their mobile phones.

Keeping in mind the fact that as many as 16% of the nurses taking part in our research admitted they never cleaned their phones even once a day and since these nurses work in the ICU, their failure to observed with rules of hygiene may turn their phones into transporters of bacteria to the patients. As a result, it is recommended to use visual notes and educations (like brochures and posters) concerning cleaning their mobile phones and limiting their use in critical units and observing the rules of hygiene in hospital. This becomes even more important when we keep in mind that cleaning mobile phones results in significant reduction of contaminations.

#### CONFLICT OF INTEREST

The authors declare no competing interests in relation to the work.

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There is no financial disclosure.

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