

# The potential role of cell phones in dissemination of bacteria in a healthcare setting

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## ABSTRACT

The mobile phone is an indispensable accessory, both from a social and a professional point of view, which is being used in a variety of environments, including those with high bacteria levels. Medical personnel, patients or even people simply passing by the healthcare facilities, having and using their mobile phones are likely to transmit bacteria, thus it might be suspected that mobile phones are to some extent a link in the cross-contamination. The purpose of this work was to collect information concerning the potential role of cell phones in a dissemination of bacteria based on available research data.

**Key words:** Cross-contamination; Mobile phone; Bacteria; Microorganisms; Healthcare personnel

## INTRODUCTION

Mobile phones are essential accessories that are being used in everyday life, both in its professional and private capacities. These devices are usually stored in handbags and/or in the pockets of their owners' clothing, therefore they are being touched by hands and come in close contact with human skin, not to mention that they are being placed on numerous surfaces countless number of time each and every day what causes the microorganisms to migrate from any other surface that the phone had contact with to a phone itself [1,2]. The average user of a cell phone touches its screen around one hundred and fifty times a day [3] causing the migration of the bacteria from the wireless phone to the skin and vice versa [4,5]. Studies conducted by Grice et al. [6] and Gricce and Serge [7] showed that the human microbiota can show interpersonal dissimilarity and that the same rule applies to the microorganisms that can be found on the human skin. Furthermore, Meadow, Altrichter, Green [8] stated in their research that in twenty-two

percent of cases studied, the microorganisms that were originally present on the hands of the owners of cell phones, have also been present on the surface of their mobile phones.

Places, which are expected to be contaminated by bacteria in a higher capacity, especially those of a public utility nature like: train stations, airports, shopping malls, schools and also the health care facilities- including the hospitals and dental clinics, are more likely to be involved in the transfer of the bacteria to the other locations by means of cell phones as carriers. Therefore, it can be presumed that the usage of mobile phones in hospitals, both by the patients, healthcare employees and people- including the visitors simply passing by, could potentially cause cross-contamination.

## The increasing role of cell phones

In the past few years, the cell phones gradually became more and more involved in our daily life, including

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its private and work-related capacities, acting not only as a primary communication tool, but also being involved in data research and storage and much more beyond that. Therefore, as the significance of wireless electronic devices increased, so did the interest in the probable side effects of their usage. Undoubtedly, a potential role of cell phones as carriers of pathogenic bacteria from one environment to another, or even from one surface to another, can be an example of such side effects. One of many attempts to investigate the correlation between the presence of the bacteria in the hospital environment and on the surface of the cell phone owned by medical personnel in one of the hospitals in Turkey has been conducted in 2007 by Karabay, Kocoglu, Tahtaci [9]. The studies aiming to explore the similar topic have also been conducted in the other parts of the world, since the cell phones became more and more affordable commodities, thus the group that has been researched increased to the point that it can be assumed that nowadays there are almost as many cell phones as there are people on Earth [10]. Based on the available data – the studies conducted by different authors all over the world in a last few years, the attempt has been made to review some of those findings, thus present the current state of knowledge on this particular matter.

## OBSERVATIONS

Among the available data regarding the possible role of mobile phones in the spread of bacteria in the healthcare settings, many different approaches to the issue in question might be found. Some of the researchers have been focused on the determination of the rate of contamination, whereas others tried to assess the number of healthcare employees involved in the study who indeed disinfected their mobile phone routinely. Yet another authors aimed to foreseen the impact of the disinfection proceedings in the long run, while others seek to compare the contamination rate between the mobile phones and landline phones, or smart cell phones and non-smart cell phones. Nevertheless, each and every method gave an insight into the matter of the potential role of cell phones in the dissemination of bacteria, yet from different perspectives.

In New York City, NY, USA, Goldblatt et al. [11], in 2007, determined that in about twenty percent of cell phones owned by medical personnel who participated in the research, microorganisms have been present on

the surface of these wireless devices. Akinyemi et al. [1] on the other hand, however, stated that based on their research it can be concluded that bacteria are present on the surface of phones in more than half of the cases – in 62% to be exact. In one of the studies conducted in Australia, among 226 wireless phones that belonged to the staff members at one of the local hospitals, in 168 devices that have been screened, the bacteria presence had indeed been discovered. The latter research also noted that the majority of the organisms that have been isolated could be described as a normal flora that can be found on the human skin, whereas only in twelve cases out of 226, the discovered microorganisms could be defined as potentially pathogenic [12].

The issue in question – the potential role of cell phones in dissemination of bacteria has been approached from slightly different angle when in 2014 Vinod Kumar et al. [13] investigated the presence of the antibiotic resistant bacteria on the surface of mobile phones owned by the patients in one of the healthcare facilities in South Arabia. According to their research, 89 out of 106 cell phones have been contaminated with bacteria and the most commonly found type of bacteria was coagulase- negative *Staphylococcus* that has been present on the surface of 52 mobile phones that have been sampled [13].

Another example of study conducted on the potential role of cell phones in dissemination of bacteria is the research conducted by Jeske et al. [4]. In this study aimed to explore whether, or not, in the exact same conditions and following the same procedure, the surface of the mobile phones and landline phones located in the operating room will be contaminated by bacteria found on physicians' hands in the similar manner. As it turned out, in case of cell phones in 38 out of 40 cases, the bacterial contamination have been found, whereas in four out of 40 instances the human pathogen bacteria have been isolated. For the landline phones, the numbers have been 33 out of 40 and four out of 40 respectively. The authors of this research also noted that the use of cell phones in the operating room could theoretically have more severe hygiene significances since the wireless devices often come in closer contact with the patient than then fixed ones. Borer et al. [5] drew the similar assumptions stating that the stationary phones can potentially be involved in the spread of bacteria, just like wireless phones possibly can, but the latter may prove particularly problematic as they may facilitate the transmission of pathogens on the larger scale.

Yet another attempt to research the potential role of cell phones in the transition of pathogens has been made when Lee et al. [14] studied the correlation between the contamination rate in the case of smart cell phones and non-smart cell phones owned by the healthcare employees. According to the obtained data, the bacteria of a possible pathogenic nature have been isolated in 34.8% of sampled smart mobile phones, while in the case of non-smart phones this number was 20.5%.

Shakir et al. [15] documented the rate of bacterial contamination of the mobile phones owned by surgeons in a long run – i.e. at the initial sampling, after the disinfection of the wireless phone and after one week of the original testing. The obtained results showed the significant decrease in the rate of bacterial contamination after the disinfection proceedings have been introduced – from initial 83% to 8%, but in following days the recontamination arose – resulting in 75% of sampled cell phones to be contaminated by potentially pathogenic bacteria. In 2012, Brady et al. [16] tested the contamination of the surface of the mobile phones twelve hours after the disinfection proceedings using the 70% isopropyl alcohol, which had been introduced. According to the obtained data, only 16% of the sampled electronic devices did indeed contain the bacteria, bearing in mind that initial rate of contamination was 55%. In other words, the authors noted the significant decrease of 79% in the contamination rate after a single disinfection.

Without any doubt, a lot of other studies have been conducted aiming to investigate the contamination rate of cell phones owned by medical personal, which have not been mentioned in this paper. The emphasis, in this paper, has been put on showing the results published by authors investigating the issue in different countries. Those results have been summarized in the table below (Table 1).

**Table 1:** The percentage contamination rate of cell phones

Country	Authors of the study	Contamination rate of cell phones (no disinfection proceedings have been introduced) (%)
USA	Goldblatt JG, et al. [2007]	20
Nigeria	Akinyemi K, et al. [2009]	62
Australia	Chao Foong Y, et al. [2015]	74
Saudi Arabia	Vinod Kumar B, et al. [2014]	84
Austria	Jeske H.C, et al. [2007]	95
UK	Brady RR, et al. [2012]	55

Up to this day, many studies have been conducted which concluded that there indeed is a correlation between the bacteria presence on the skin of the owner of the cell phone and the wireless device itself [17-22]. Walia et al. [23] even suggested that the cell phones might, theoretically, act as ‘Trojan horses’ triggering the development of the diseases caused by pathogens that are usually present mostly in hospitals and in the dental clinics. On the other hand, however, the conclusions drawn by Tacconeslli [24] seem to contradict the thesis about cell phones and their role as the ‘Trojan horses’, since, according to Tacconeslli, there is no direct correlation between the presence of pathogens on the mobile phones and the frequency of the diseases that are primarily caused by pathogens present mostly at the health care facilities. Furthermore, we lack an unambiguous data stating that cell phones are indeed more likely to be involved in the spread of bacteria from one place to another than any other mobile devices or personal items. Additionally, Karabay, Kocoglu, Tahtaci [9] noted that pathogens involved in development of hospital infection could potentially spread through medical instruments like stethoscopes or personal items-toys in pediatric care units can serve as an example [25], and even by means of the hands of the healthcare personnel.

Still, though, it should be pointed out that according to Datta, Rani, Chander, Gupta [21] in a hospital in India, where they have carried out their research, there were no general guidelines on the way in which the employees have to take care of their phones while at work, nor has it been pointed out where the phones can be used and in which areas it is strictly prohibited. Such lack of basic information and guidelines may increase the probability of cross-contamination and so, the simple methods as disinfection of the cell phones or the restriction of their usage might, at least theoretically, lower the risk of the spread of bacteria. Likewise, Karabay, Kocoglu, Tahtaci [9] drew the similar conclusions and also they pointed out that the restrictions on the use of cell phones in the health care institutions by medical personnel are impractical since those mobile devices can be considered as essential instruments for healthcare workers, therefore the emphasis should be put on the prevention of the spread of bacteria through mobile phones by, for instance, means of proper hand hygiene and disinfection of mobile phones. Borer et al. [5] suggests that strategies that target the behavioral regulation of medical personnel should be applied – like the enforcement of the infection prevention methods, as well as the disinfection methods of the mobile

phones. Furthermore, with no doubt, the hand hygiene among the healthcare workers ought to be monitored and the feedback regarding their performance is more than welcomed.

The similar remarks as to the role of the disinfection of the mobile phones has been made in 2015 by Heyba, Ismaiel, Alotaibi et al. [22] who have noticed that 66.5% of the researched group never had properly disinfected their phones, this number was even higher in the case of studies conducted in Saudi Arabia [24] –76%, whereas in Northern Ireland only 37% of medical employees that have participated in the study had disinfected their wireless electronic devices [26]. In Australia, merely 31% of staff members of local healthcare institution had reported cleaning their cell phones on a daily basis, while 21% of the researched group stated that they use alcohol-containing wipes to do so [15]. Even the lower number of employees of healthcare institution that was involved in the research conducted by Brady et al. [18] admitted to cleaning their cell phones regularly – eight percent to be exact. In the same study, after the mobile phones have been disinfected, the significant decrease (by 79%) in the contamination rate of their surfaces has been reported.

It should be pointed out that the cell phones that can be found in a healthcare facilities are not only those owned by the medical personnel, but also by the patients themselves and the mentioned electronic devices should also be considered as potential carriers of bacteria. Indisputably, the research concentrating on the probable dissemination of pathogens through cell phones owned by medical personnel remains a majority of the studies developed on this particular topic, whereas the probable role in the spread of bacteria of the wireless electronic devices owned by the patients or even the visitors simply passing by the medical facilities, still remains fairly undeveloped matter. Brady et al. [18] in their research had put an emphasis on the bacterial colonization of the mobile phones owned by patients and the patients' awareness of possible cross contamination. Among the group involved in the study, 86.4% of patients who declared owning the mobile phone did bring it into the hospital. The majority of responders –70.3%, stated that they are aware that cell phones can be contaminated by bacteria and that bacteria can spread through cell phones from one location to another. Yet, according to the data provided by the authors, not even a single patient has been informed about mobile phones utilization guidelines during their hospital stay. As far as the

disinfection proceedings prior to their hospital stay, 50.9% of patients stated that they have never cleaned their mobile devices, 6.9% admitted to disinfecting them annually, 11.8% monthly, 17.6% weekly, while 12.7% daily. Only 10.8% of the patients involved in a study declared that they have disinfected their wireless electronic devices while staying at the healthcare facility. Also, the authors noted that they did not find a single patient who declared sharing his/hers phone with any other patient, although some of them declared that they probably would, if asked. Therefore, it is advised to introduce the guidelines for patients addressing the proper handling of the cell phones and appropriate disinfection methods that can be both applied on a daily basis and even more importantly after their admission to a hospital.

It seems that more and more health care institutions make an attempt to introduce guidelines addressing the proper handle of electronic devices, including cell phones that aim to prevent the spread of bacteria. In 2012, in Canada, for instance, the CHICA- Canada Practice Recommendations has issued a guideline addressing the matter of the presence and usage of electronic devices, including the wireless phones in the healthcare facilities [27]. In that document addressing the Infection Prevention and Control Related to Electronic (IT) Devices in Healthcare Settings, the standards and protocols focusing on infection prevention and control considerations for electronic appliances have been outlined. Among them, the following recommendations have been made: hand hygiene ought to be performed prior to contact with a patient as well as before and after accessing the electronic appliance; the devices that cannot be properly disinfected should not be used in patient rooms and all surfaces of electronic devices that are accessed at or close to point-of-care must be disinfected with a hospital-grade disinfectant [28]. Nevertheless, in general, there is a shortage of guidelines addressing the issue of proper handling of the cell phones by the patients and visitors while residing at a healthcare facility, nor it is clearly stated in which areas those wireless devices can be used and in which zones it is strictly prohibited. Therefore, it is advised to issue such guidelines, since it may, at least theoretically, increase the awareness of the possible contamination of the surface of the wireless electronic device among people without medical background, and may help prevent the possible spread of pathogens through mobile phones.



## CONCLUSIONS

Some of the pathogens that can be found on the human skin basically migrated from other places and surfaces. Each time we touch an object or simply when we are present in a different environment - we are in direct or indirect contact with pathogens that are present on those surfaces or in those places and thus, some of the microorganisms migrate on our bodies and vice versa. In other words, we frequently transfer the microbes from and to our surrounding and that includes our belongings.

The correlation between a person's microbiome and one's health is so to speak extremely complex and still rather poorly comprehended [29]. As the research on this matter continuous, the noninvasive sampling of personal items, like cell phones, especially in case of healthcare employees can possibly be useful in the detection and inhibition of the spread of bacteria, hence improving the prevention of probable cross-contamination. Proper care should be taken while using the wireless electronic devices, especially at the point-of-care. The same rules should also be applied, at least to some extent, to the patients and visitors of healthcare facilities when they are accessing their mobile phones, since pathogens could potentially spread through their personal belongings – including their cell phones, as well. Moreover, the employees of medical facilities and also individuals lacking the medical background- including the patients, should be educated about the possibility of the spread of bacteria through their personal belongings, including their wireless electronic devices, since, at least theoretically, increasing the knowledge about measures to prevent the probable contamination, may indeed led to lower cross- contamination rate.

Mobile phones, generally speaking, are carried by their owners constantly and therefore they are more prone to come in contact with foreign microorganisms in comparison to the objects that are being used less frequently or only in a certain environment, yet cell phones can still be involved in the spread of the pathogens from one place to another, just like any other objects. Therefore, it is essential to increase the awareness of this particular issue, especially among the healthcare personnel, as well as to introduce the means to prevent the spread of bacteria through wireless phones.

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