



THE BACTERIAL CONTAMINATION OF NURSES' MOBILE PHONES IN A GENERAL HOSPITAL IN KERMANSHAH, WEST OF IRAN

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ABSTRACT

Introduction

Mobile phones are electronic devices for personal communication and they have become necessary accessories in social life. These devices have potential role in transmission of infectious agents. In this study, we investigated the rate of bacterial contamination of nurses' mobile phones in a general hospital in Kermanshah, west of Iran.

Materials and Methods

A total of 64 samples were collected from nurses' mobile phones in a general hospital in Kermanshah, west of Iran. Samples were collected with help of sterile cotton swabs moistened. Then mobile phones were cleaned with 70 percent ethanol alcohol. Bacterial isolates were identified using microbiological and biochemical standard tests. Antibiotic susceptibility testing were performed according to Kirby–Bauer method.

Results

Out of 64 nurses, 47 cases were female (73%). The mean age was 32.8±16.3 years. All of mobile phones samples grew organisms. Fifty-five cases (85.9%) and 9 cases (14.1%) had a single and two types of colonies. The most common detected bacteria was coagulase-negative staphylococcus (76.6%). The mean colony-forming units (CFUs) counts before and after cleaning were 74.34±14.56 and 11.78±5.24, respectively (p<0.001). Twenty cases (31.2%) of mobile phones showed no growth after such cleaning (p<0.001).

Conclusion

Results of present study showed that high rate contamination of nurses' mobile phone in this hospital. Cleaning of mobile phones with 70% ethanol reduced significantly mean CFUs counts. The cleaning of mobile phones as well as hand hygiene are necessary in order to avoid transfer of infection by these devices.

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Introduction

Nosocomial infection is an important problem in healthcare systems specially hospitals [1]. These infections increase the length of stay of patients, costs and mortality [2]. Most of the diagnosed nosocomial infections are caused by bacteria that

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they have acquired resistance to the most of common antibiotics. The source of these infection may be exogenous such as medical equipments and hands of health care workers (HCWs) such as nurses or endogenous such as skin flora of patients. Nurses are involved in direct patient care. Hands of HCWs have a strong potential for transmission of infectious agents to hospitalized patients [3]. Mobile phones are electronic devices for personal communication and they have become necessary accessories in social life that are easily available, economical and user-friendly, so they are widely used by HCWs in every location in health care systems [4]. Mobile phones are used in close contact with the hands, face, mouth and ears of self-users. HCWs rarely disinfect them, so they have potential role in transmission of infectious agents [5, 6]. In addition, results of performed previous studies show more than 90% of mobile phones of HCWs were contaminated with different bacteria that commonly cause of hospital infections [7]. Researcher have isolated normal flora and some pathogen bacterial agents such as *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Acinetobacter* spp from mobile phone's samples [8]. Regarding to the importance of nosocomial infections as one of the major health challenges and also the significant role of mobile phones in transferring bacterial agents, in present study, we investigated the bacterial contamination rate of nurses' mobile phones in a general hospital in Kermanshah, west of Iran.

Materials and Methods

In this cross-sectional study between July 2015 and September of 2015, a total of 64 mobile phones belong to nurses in a general hospital in Kermanshah, west of Iran, were selected. The nurses randomly were selected from 4 wards including general surgery, intensive care units (ICUs), the operation room (OR) and infectious diseases wards. Samples were collected with help of sterile cotton swabs moistened with sterile normal saline was rolled by rotating the swabs over the mouthpiece, earpiece, keypad and external cover of the mobile phones of the study participants. The mobile phones were cleaned with 70 percent ethanol alcohol (Merck Co, Germany). After allowing it to dry, swab samples were taken again based on procedure which were mentioned in above. All swabs were streaked onto two plates including 5% sheep blood agar and MacConkey's agar (Hi-Media, India). The plates were incubated at 35°C, for 48 h. after growing, the mean number of colony-forming units (CFUs) were measured. For initial identification of bacterial isolates, we used standard microbiological methods such as colony morphology, gram staining, catalase and oxidase test. The final identification of isolates were carried out by using API systems (bioMerieux, France) [9].

Antibiotic susceptibility testing of bacterial isolates were performed by Kirby–Bauer method according to Clinical Laboratory Standard Institute (CLSI) guidelines (10). Mueller-Hinton (MH) agar was used as the test medium. A sterile cotton-tipped swab was dipped into the standardized suspension (1.5×10^8 CFU/ml) and was inoculated onto the entire surface of MH agar plate. Appropriate antibiotic disks including chloramphenicol (30µg), gentamycin (10µg), amikacin (10µg), ampicillin (10µg), ceftriaxone (30µg), ofloxacin (5µg), erythromycin (15µg), tetracycline (30µg), cotrimoxazole (5µg), ciprofloxacin (5µg) augmentin (12.5µg) and streptomycin (1µg) (Hi-Media, India) were placed on the agar. Methicillin-resistant *Staphylococcus aureus* (MRSA) was confirmed by testing with an ceftioxin (10µg) disk on MH agar with 4% NaCl and incubated at 35°C for twenty-four hours. The diameters of the inhibition zones were measured with a ruler and compared with a zone-interpretation chart [10]. *Pseudomonas aeruginosa* ATCC 27853 and *Escherichia coli* ATCC 25922 were used as quality control strains.

Statistical analysis

Statistical analysis of data was performed using with the SPSS program version 16. Differences between results were analyzed by the Student's t-test. A P value of less than 0.05 was considered statistically significant.

Results

Out of 64 nurses, 47 cases (73.4%) were female. The mean age of participants were 32.8 ± 16.3 years. The nurses were from different hospital wards as follows, general surgery (35.9%), ICU (29.7%), the operation room (18.8%) and infectious diseases ward (15.6%). All the participants accepted using mobile phones in the hospital. The most of participants reported never washing their hands (87%) and mobile phones (90.6%) before and after using the their mobile phones (87%).

All of samples grew bacteria. Fifty-five cases (85.9%) and 9 cases (14.1%) had a single and two types of colonies, respectively. The most common detected bacteria were coagulase-negative staphylococcus (76.6%) and staphylococcus aureus (15.6%). There is no methicillin-resistant staphylococcus aureus (MRSA). The mean colony-forming units (CFUs) counts before and after cleaning with 70% ethanol alcohol were 74.34 ± 14.56 and 11.78 ± 5.24 , respectively that there was a statistically significant reduction in the bacterial load ($p < 0.001$). All of gram negative bacteria didn't grow after cleaning. Twenty cases (31.2%) of mobile phones showed no growth after such cleaning ($p < 0.001$) (Table 1). Results of antibacterial susceptibility testing showed fluoroquinolone antibiotics (ofloxacin and ciprofloxacin) were the most effective antibiotics (Table 2).

Table 1. The types of bacterial isolates from mobile phones

Bacterial isolates	Before Cleaning N (%)	After Cleaning N (%)	P value
Coagulase-negative Staphylococci (CoNS)	49 (76.6%)	34 (53.1%)	<0.001
staphylococcus aureus	10 (15.6%)	8 (12.5%)	NS
Bacillus spp	7 (10.9%)	2 (3.3%)	NS
Entrobacter spp	3 (4.7%)	0 (0%)	NS
Citrobacter spp	2 (3.1%)	0 (0%)	NS
Acinetobacter spp	1 (1.5%)	0 (0%)	NS
Escherichia coli	1 (1.5%)	0 (0%)	NS
Total	64 (100%)	44 (100%)	<0.001
Overall CFU (mean±SD)	74.34±14.56	11.78±5.24	<0.001

NS: Not significant statistically

Table 2. Results of antibiotic susceptibility testing of the most common bacterial isolates

Antibiotic	Coagulase-negative Staphylococci (n=49) (Sensitivity) N (%)	staphylococcus aureus (n=10) (Sensitivity) N (%)
cotrimoxazole	13 (26.5%)	3 (30%)
chloramphenicol	14 (28.6%)	5 (50%)
ceftriaxone	33 (67.3%)	5 (50%)
erythromycin	18 (36.7%)	4 (40%)
gentamycin	27 (55.1%)	4 (40%)
streptomycin	26 (53.1%)	6 (60%)
ampicillin	13 (26.5%)	3 (30%)
amikacin	15 (30.6%)	3 (30%)
augmentin	12 (24.4%)	2 (20%)
ofloxacin	39 (79.6%)	7 (70%)
ciprofloxacin	37 (75.5%)	8 (80%)

Discussion

Nosocomial infections are serious problem in the health care system such as hospital. Medical equipment and accessories such as mobile phones play a significant role in disseminating of infection agents in these systems [11, 12]. The results of this study showed that all of the studied cases were infected with at least one bacterium that many of them have potential to cause infections. This result is similar to other studies which were reported the contamination rate of mobile phones to range from 88 to 97% [12-15]. Many of HCWs including nurses aren't familiar to potential risks of poor mobile phone hygiene in transferring bacterial agents to hospitalized patients.

Research has indicated that warmth and moisture of hands can create a suitable context for the growth of various microorganisms [12]. Results of previous studies show that the most commonly isolated bacteria from mobile phones belong to the skin normal flora are transferred easily to the these instruments [16]. In our study, the highest rate of contamination related to Coagulase-negative Staphylococci (CoNS), accounting for 76.6% , which is included among the normal flora. It reports a higher percentage as compared to other study that was performed by Akinyemi in Nigeria who reported that 50% of mobile phones contaminated with Coagulase-negative Staphylococci (CoNS) [17]. Whereas, Sedighi reported a higher percentage of 82.4% for the infection of mobile phones with Coagulase-negative Staphylococci (CoNS) in Iran [18]. Coagulase-negative Staphylococci (CoNS) can turn into a major nosocomial infection related to catheters and other medical equipment. Therefore, their isolation can pose a major challenge in the healthcare systems. In different studies, Coagulase-negative Staphylococci (CoNS) followed by staphylococcus aureus comprise the most significant gram positive isolates separated from mobile phones [16]. Staphylococcus aureus is commonly found on the skin and in the nose, but it can also be transferred internally. This bacterium is the most common bacterial agents of nosocomial infections. It can be found in one third of the adults, and due to their presence on mobile phones can cause their spread in hospitals [16]. In present study, staphylococcus aureus isolated from 15.6% of tested mobile phones. Other performed study in Iraq reported the contamination rate to staphylococcus aureus (45%) that was higher than our results [19]. Strains of Bacillus in our study which were isolated with 10.9% can be the cause of opportunistic infections in immune compromised patients. These strains are capable of producing spores which are resistant to heat, dryness, and some chemical disinfectants. Therefore, their presence on mobile phones can pose serious risks [19].

The presence of both gram positive and negative bacteria on mobile phones can be a cause of transferring such diseases as diarrhea, pneumonia, abscess, and so on [16]. In our study, fecal coliforms were isolated with 9.3% of cases. Bacteria such as *Acinetobacter* are resistant against dryness and can survive for weeks. They might as well have the potential for multiple-drug resistance. These bacteria can also contribute significantly in nosocomial infections especially in immune-deficient hospitalized patients [16]. In a study by Mohammad in Saudi Arabia, about 24% of cellphone isolates included coliform bacteria, representing a higher percentage than our study [14]. The results of our study, however, showed the CFUs counts before and after cleaning with 70% ethanol alcohol were 74.34 ± 14.56 and 11.78 ± 5.24 , respectively that there was a statistically significant reduction in the bacterial load ($p < 0.001$). Growth of gram negative bacteria declined significantly compared to gram positive ones, and no gram negative bacteria was detected to grow after cleaning with 70% ethanol alcohol. The wall of gram negative bacteria is mainly made up of lipids which allows more penetration of ethanol into the bacterial cell, leading to its death. Tiwari showed that disinfecting mobile phones with alcohol could significantly reduce bacterial load in the samples [12]. The results of Goldblatt et al indicated that bacterial infection dropped as much as 88% after disinfecting with alcohol [20].

Conclusion

In general the results of this study showed the most of the nurses' mobile phones in this hospital were contaminated by various bacterial agents can be transferred to hospitalized patients. Mobile phones are widely-used devices, and due to their importance for HCWs such as nurses, limiting or banning them in hospitals cannot be a practical solution. Therefore, an urgent need is detected for educating HCWs on the possible infection of mobile phones and the importance of their periodic cleaning as well as hand hygiene in order to avoid transfer of infection by mobile phones.

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