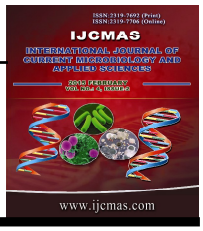
Int.J.Curr.Microbiol.App.Sci (2015) 4(2): 75-81

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 4 Number 2 (2015) pp. 75-81**
http://www.ijcmas.com



Original Research Article

Bacterial Contamination of Mobile Phones and Pens in Pediatric and Neonatal Intensive Care Units

Saeedeh Haghbin[1]*, Bahman Pourabbas[1,2], Zahra Serati[1], and Abdolvahab Alborzi[1,2]

[1]Department of Paediatrics, Namazi Hospital, Shiraz University of Medical Sciences, Shiraz, Iran
[2] Clinical Microbiology Research Center, Namazi Hospital, Shiraz, Iran
**Corresponding author*

Keywords

Nosocomial infection, Mobile phone, Hand hygiene

A B S T R A C T

The use of personal accessories such as cell phones, writing pens and their association with nosocomial infections in the hospitals is a matter of concern. The present study examined the bacterial contamination of mobile phones and pens and their sensitivity patterns of the personnel, employed in the PICU and NICU, in Namazi Hospital, Shiraz, Iran. A total of 83 health care workers were enrolled into the study. Cultures were obtained during the working hours from their pens and cell phones. Samples were prepared on 5% sheep blood and MacConkey agar plates. Meanwhile, questionnaires on cell phones and hand hygiene were filled. As revealed, none of participants routinely cleaned their phones or pens before entering the ward, and only 23% washed their hands before using the devices. Growth was observed in 77.11% of the cell phone and 84.34% of pen samples. The most common isolated gram-positive bacteria were Coagulase-Negative *Staphylococci* and gram-negative ones were *Pseudomonas* species. Cell phones and stationery could be the source of bacterial infection transmission in the hospitals. Therefore, the infection control precautions by medical personnel such as regular hand hygiene before the devices use, their decontamination, and developing guidelines in this respect could be very helpful.

Introduction

Nosocomial infections are an important health issue in modern hospitals and affects both developed and resource-poor countries. They are defined as the infections occurring within 48 hours of hospital admission, 3 days of discharge or 30 days of an operation (Inweregbu *et al.*, 2005). Each year, two million patients acquire health care associated infections resulting in 90,000 deaths (Burke, 2003). The highest frequencies of nosocomial infections were reported from hospitals in the Eastern Mediterranean and South-East Asia regions, with the highest rate occurring in intensive care units (ICU) (Inweregbu *et al.*, 2005). Infections acquired in health care settings

are among the major causes of death and increased morbidity among hospitalized patients. The economic costs are considerable chiefly due to the increased length of stay for the respective patients.

Environmental organisms in the hospitals may contaminate objects, devices, and materials which subsequently contact susceptible body sites of the patients. Some epidemiological studies have implicated environmental surface in the transmission of the organisms (Neely, 2007; Ulger *et al.*, 2009). As early as 1866, it was established that health care workers play an important role in reducing the rate of bacterial transmission to the patients by regular hand washing (Ulger *et al.*, 2009). Many of personal instruments used daily by medical health care workers (HCW), such as stethoscope, cell phones and writing pens in the hospitals can act as carriers of the infection (Neely, 2007).

The global system for mobile telecommunication was established in 1982 in Europe with a view of providing an improved communications network. Nowadays, mobile phones have become one of the most indispensable accessories of professional and social life. This device is used routinely in every location in hospitals by patients, visitors and HCWs, as a means of communication and a source of information. Mobile phones were not allowed in ICU environments until a few years ago due to interference with medical equipment. However, this rule is no longer in place and cell phones can be used away from medical devices in ICUs.

Increasing functionality and affordable prices for cell phones have resulted in a global reliance on staying connected everywhere. These factors and the heat generated by cell phones contribute to bacterial growth on the device at alarming rates. Given daily contact of cell phones with the face, hands, and different surfaces in the hospitals, the dire health risks of using them become obvious. In spite of their widespread use in hospitals and ICUs, there are no cleaning guidelines available that meet hospital standards. Unlike our hands, which can easily sterilized using hand sanitizers available readily across all hospitals and medical facilities, the mobile phones are burdensome to clean and even we rarely make an effort to sanitize them. Some researchers reported up to 99% of HCWs cell phones in developing countries demonstrated evidence of bacterial contamination with 64.8% revealing bacterial pathogens (Neely, 2007). Later, some similarities were reported between the isolated micro-organisms from cell phones and HCW's hands (Bhat *et al.*, 2011). Such findings raised the question if the personal instruments of medical HCWs could be source of nosocomial infections and act as a transmission route from patient to patient (Neely, 2007; Datta *et al.*, 2009; Brady *et al.*, 2011; Mohammadi-Sichani and Karbasizadeh, 2011).

In this study, we investigated bacterial contamination of cell phones and pens of HCWs employed in pediatric and neonatal ICUs (PICU and NICU), Namazi Hospital, Shiraz, Iran and evaluated the role of cross-transmission among them.

Participants and Methods

The present study was a descriptive cross-sectional one, carried out in a 10 bed general PICU and 12 bed NICU, at Namazi Hospital, Shiraz, Iran in fall 2012. Both ICUs were referral centers in the teaching hospital, affiliated with Shiraz University of Medical Sciences. Because of limited number of staffs and physicians working in ICUs, all who worked with patients, and had cell phones and signed consent form,

entered the study. A total of 83 HCWs consisting of 20 doctors, 48 nurses and 15 other workers were enrolled into the study. Cultures were obtained randomly without previous notice during the working hours, from their personal pens and cell phones. Samples were prepared using swabs moistened with sterile saline and streaked on 5% sheep blood agar and MacConkey agar plates. All cultures were prepared by a single person. All the plates were incubated at 37°C for 24 hours and observed for growth.

The isolates were identified on the basis of colony morphology, Gram- stain, and standards biochemical reactions. To identify gram-negative bacteria, API system (bioMerieux, France) was used. A slide coagulase test differentiated staphylococcal isolates into *Staphylococcus aureus* and Coagulase-negative *Staphylococci* (CoNS). Oxacillin sensitivity of the *Staphylococci* and ceftazidime sensitivity of the gram negative isolates were investigated by disk diffusion method according to Clinical Laboratory Standards (CLSI) criteria (Killic *et al.*, 2009). A questionnaire was used for data collection on the use of cell phones in ICUs, method and episodes of mobile and pen decontamination, hand washing and hygiene in ICUs, and filled for the respective HCWs prior to sampling.

The study protocol was approved by the local research committee of Shiraz University of Medical Sciences. Consents were obtained from the participants whose related data were kept secret and the respective results were used for infection control within the intensive care units of the hospital. Data analysis was performed using SPSS version 18 software.

Result and Discussion

This study was carried out in our medical PICU and NICU, in 2012. In total, 83 health staffs including 20 doctors and 63 nurses and other workers were enrolled in this study. Age of HCWs that participating in this study ranged from 23 to 45 years with mean of 34.7 consisting of 89.16% women and 10.84% men. All of them used their cell phones at least once during working hours. While none of them routinely cleaned their mobiles or pens before entering the ward, 23% of them washed their hands before using the device. Only 10% of HCWs cleaned their phones using alcohol wipe occasionally.

Out of 83 samples evaluated, growth was observed in 77.11% of phones and 84.34%of pen samples. With regard to the number of organisms, 33.7% of mobile phone and 22.9% of pen samples grew two or more species (Table 1).

Bacteriologic analysis revealed that the most common isolated organism was CoNS with 40.00% and 51.04% from mobiles and pens samples, respectively (Table 2). Numbers of isolated Gram-positive bacteria were higher than that of Gram-negative ones. The most common isolated gram-positive bacteria were CoNS and gram-negative bacteria were Pseudomonas spp. (Table 2). Methicillin-resistant staphylococcus aureus (MRSA) grew in 6% of the mobile samples and 5.21% of pen samples (Table 2). There were 3 cases with positive culture for MRSA from mobile and pen, simultaneously. Three other cases just had positive result for MRSA from their mobile samples. There was just one case with positive culture for Acinetobacter spp. from both two samples. The bacteria potentially associated with nosocomial infections were isolated in 60% and 48.95% of mobile and pen, and included MRSA, methicillin-sensitive *Staphylococcus aureus* (MSSA), *Enterococcus, Acinetobacter* and *Dipheroid spp*.

In this study, bacterial contamination was detected in 77.11% of the cell phones and 84.34% of the pens. This finding highlights mobile phones and pens as a potential threat in infection control practices, which could aggravate rate of healthcare - associated infections. Different studies reported that bacterial pathogens like vancomycin-resistant *Enterococci* (VRE) and *Klebsiella spp*. are easily transferred from hard plastic or metal and soft surfaces to the hands of HCWs by touch (Neely, 2007). A similar study on the writing pens revealed that the pens used by HCWs were much more contaminated than those used by non-HCW counterparts (Patil *et al.,* 2010). Cell phones and pens are among the most frequently used items at the patients' bedsides by the health staffs. The easy availability cell phones have made this device an indispensable part of life. Considering too frequent daily hand and face contact with cell phones, many researchers reported them as a potential reservoir of bacterial colonization in 61% to 99% in different centers (Burke, 2003; Neely, 2007; Datta *et al.,* 2009; Brady et al., 2011; Mohammadi-Sichani and Karbasizadeh, 2011). Although stationary phones were reported to be the source of bacterial colonization, mobile phones are particularly important in terms of intra and inter ward and sometimes inter-hospital transmission (Singh *et al.,* 1998). Cell phones and pens can serve as a source of bacterial pathogens around the patients. The present study revealed that the isolated micro-organisms from cell phones and pens were similar (Table 2).

CoNS was the most frequent organism isolated in this study. This finding was consistent with those of some previous reports (Singh *et al.,* 1998; Karabay *et al.,* 2007; Datta *et al.,* 2009; Killic *et al.,* 2009; Jean-Baptiste *et al.,* 2011; Mohammadi-Sichani and Karbasizadeh, 2011). As demonstrated in respective epidemiological studies, this organism is a normal flora on the skin and differentiating its infection from contamination is challenging. Although its infections are associated with mild clinical symptoms in most cases, this organism is the most common cause of blood stream infection in NICU and PICU settings, which can cause significant mortality and morbidity (Venkatesh *et al.,* 2006). Accordingly, CoNS has been reported to be frequent in groups of patients including neonates, immune-compromised cases, those with indwelling intravascular devices, ventricular shunts, peritoneal catheters or other implanted medical devices (Choi *et al.,* 2008).

According to the results, MRSA recovered from 11 samples (6 of cell phone, 5 of pen) which could be a cause of concern. This organism is increasingly spreading not only among the hospitalized patients but as recent studies show, it has some impact on serious community acquired infections (Harbarth *et al.,* 2005; Miller *et al.,* 2005). Also, these bacteria are often resistant to multiple commonly used antimicrobial agents, which can infect both healthy children and immune-compromised ones. It is indeed surprising to document the presence of MRSA in the mobile phones and pens from HCWs working in PICU and NICU because such environments are routinely screened and controlled by infection control teams and such organisms are extremely fatal in such units.

The other detected organism which attracts attention is *Acinetobacter spp*. In the present study, it was recovered from 4 samples totally (Table 2). This organism is among multiple-resistant species causing nosocomial infections in hospitalized patients. As reported in a study, it was the commonest isolated gram-negative bacilli recovered from cell phones used by HCWs.

Table.1 Extent of organism isolated from cell phones and pens

Number of organism	Cell phone N (%)	Pen N (%)
0	17 (20.5)	12 (14.5)
1.00	38 (45.8)	52 (62.6)
2.00	22 (26.5)	13 (15.7)
3.00	6 (7.2)	6 (7.2)
Total	83 (100)	83 (100)

Table.2 Types of organism isolated from cell phones and pens

	Cell phone		Pen	
Type of organism	Number	%	Number	%
CoNS*	40	40.00%	49	51.04%
MRSA*	6	6.00%	5	5.21%
MSSA*	10	10.00%	9	9.38%
Strep viridance	10	10.00%	4	4.17%
Bacillus spp.	10	10.00%	10	10.42%
Diphteroid spp.	11	11.00%	9	9.38%
Enterococcus spp.	6	6.00%	4	4.17%
Acinetobacter	3	3.00%	1	1.04%
Pseudomonas spp.	4	4.00%	3	3.13%
Salmonella spp.	0	0	0	0
Candida spp.	0	0	1	1.04%
Total	100	100	96	100

*MRSA: Methicillin resistant *Staphylococcus aureus*; CoNS: Coagulase-negative *Staphylococci* MSSA: Methicillin sensitive *Staphylococcus aureus*

The bacteria can survive for weeks and multiply rapidly in a warm environment due to resistance to drying (Borer *et al.*, 2005).

Analysis of the questionnaire showed that only 10% of the HCWs cleaned their mobile phones with disinfectant and none of them cleaned their cell phones or pens routinely. There is an urgent need to educate HCWs about the possible contamination of mobile phones and the importance of periodic cleaning of the phones and pens, as well as the importance of hand hygiene to prevent infection transmission.

Considering the present results, it seems that cell phones and stationery could be the sources for transmission of hospital acquired infections to the patients. Also, since there is no particular guideline for handling the cell phones inside ICUs, their increasing use could be a health concern. Being used very widely and their importance for HCWs, restriction or deletion from ICUs cannot serve as a practical solution. Therefore, it is recommended that the ICU personnel be more careful and attentive to infection control precautions such as strict hand washing before entering ICU, regular hand

hygiene before and after each patient's touch, regular hand hygiene before and after mobile touch, daily decontamination of cell phone and stationery used by them, and avoiding the use of shared stuffs including stethoscope and penlight for different patients. In addition, developing respective guidelines and instructions for cleaning and decontaminating of the cell phones to be followed in ICUs, could be very helpful.

This study has some limitations. It is not concluded from the study whether the bacteria were transient or permanent because sampling was performed just once. Due to limited number of PICU and NICU staff, the study cannot generalize to similar settings. However, the result of the study may attract our attention to important organisms which can be found in ICU settings. Meanwhile, further studies on the effective type of disinfectant used for stationery and personal accessories in medical environment are also warranted.

Acknowledgment

Our thanks go to Hassan Khajehei, for linguistic editing of the manuscript.

References

Bhat, S.S., Hegde, S.K., Salian, S. 2011. Potential of mobile phones to serve as a reservoir in spread of nosocomial pathogens. *Online J. Health Allied Sci.*, 10(2): 14.

Borer, A., *et al.* 2005. Cell phones and *Acinetobacter* transmission. *Emerg. Infect. Dis.*, 11(7): 1160–1161.

Brady, R., *et al.* 2011. Mobile phone technology and hospitalized patients: a cross-sectional surveillance study of bacterial colonization, and patient opinions and behaviours. *Clin. Microbiol. Infect.*, 17(6): 830–835.

Burke, J.P. 2003. Infection control-a problem for patient safety. *New Engl. J. Med: NEJM.*, 348(7): 651–656.

Choi, G., van den Borne, M.P.J., Visser, C.E., Kersten, M., Kater, A.P. 2008. Invasive infections with a coagulase-negative *Staphylococcus* in an immunocompromised patient: case report and review of the literature. *Ann. Hematol.*, 87: 771–772.

Datta, P., Rani, H., Chandder, J., Gupta, V. 2009. Bacterial contamination of mobile phones of health care workers. *Ind. J. Med. Microbiol.*, 27(3): 279.

Harbarth, S., *et al.* 2005. Community-associated methicillin-resistant Staphylococcus aureus, Switzerland. *Emerg. Infect. Dis.*, 11(6): 962–965.

Inweregbu, K., Dave, J., Pittard, A. 2005. Nosocomial infections. *Contin. Educ. Anaesth. Crit. Care Pain.*, 5(1): 14–17.

Jean-Baptiste, N., *et al.* 2011. Coagulase-negative staphylococcal infections in the neonatal intensive care unit. *Infect. Control Hosp. Epidemiol.*, 32(7): 679–686.

Karabay, O., Kacoglu, E., Tahtaci, M. 2007. The role of mobile phones in the spread of bacteria associated with nosocomial infections. *J. Infect. Dev. Count.*, 1(1): 72–73.

Killic, I., Ozaslan, M., Karagos, I., Zer, Y., Davutoglu, V. 2009. The microbial colonisation of mobile phone used by healthcare staffs. *Pak. J. Biol. Sci.: PJBS*, 12(11): 882–884.

Miller, L.G., *et al.* 2005. Necrotizing fasciitis caused by community-associated methicillin-resistant

Staphylococcus aureus in Los Angeles. *New Engl. J. Med.: NEJM.* 352(14): 1445–1453.

Mohammadi-Sichani, M., Karbasizadeh, V. 2011. Bacterial contamination of healthcare workers' mobile phones and efficacy of surface decolonization techniques. *Afr. J. Microbiol. Res.,* 5(30): 5415–5418.

Neely, A.N. 2007. Persistence of micro-organisms on common hospital surfaces: strategies to control their dissemination. *Infect. Control Resour.* 4(4): 1–8.

Patil, P., Hulke, S., Thakre, A., Gaikwad, M. 2010. Pen of health care worker as vector of infection. *Online J. Health Allied Sci.,* 9(3): 15.

Singh, V., Aggarwal, V., Bansal, S., Garg, S., Chowdhary, N. 1998. Telephone mouthpiece as a possible source of hospital infection. *J. Assoc. Physicians India,* 46(4): 372–373.

Ulgar, F., Esen, S., Dilek, A., Yanik, K., Gunaydin, M., Leblebicioglu, H. 2009. Are we aware how contaminated our mobile phones with nosocomial pathogens? *Ann. Clin. microbial. Antimicrob.* 8(1): 7.

Venkatesh, M.P., Placencia, F., Weisman, L.E. 2006. Coagulase-negative staphylococcal infections in the neonate and child: an update. In: Seminars in pediatric infectious diseases, Elsevier. Pp. 120–127.