Original Research Article

Mobile Phones are Silent Threat

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A B S T R A C T

Keywords	Mobile phones have become an extension of office practice for physicians; they act as perfect substrate for microorganisms, especially in hot humid conditions, and may serve as a vehicle in transmitting nosocomial infections. This study was conducted to determine whether mobile phones of healthcare workers (HCWs) harbour microorganisms of pathological significance or not. Swabs were taken from 200 mobile phone surfaces, of HCWs, cultured on Blood agar and MacConkey agar plates, and incubated aerobically. Growth was identified as per standard microbiological procedures. A self-administrated questionnaire was completed by all participants. Among the collected 200 samples, 92.5% samples were contaminated. Coagulase negative *Staphylococci* (CONS) was the most frequently (39%) encountered bacterial agent. While MRSA was the second bacterial agent recovered (29%). *E. coli, Acinetobacter* spp., and *Candida albicans* were also isolated with variable frequencies. High level of mobile phones contamination irrespective of the environment is disturbing. Isolation of potential pathogenic species from HCWs mobile phones is a cause for concern, indicating the potential threat of these phones spreading nosocomial and community acquired infections and the importance of hand hygiene to prevent infection.
Health care workers, Mobile phones, MRSA, CONS, HAIs	

Introduction

The global system for mobile telecommunication (GSM) was established in 1982 in Europe with a view of providing and improving communication network. Today, mobile phones have become one of the most indispensable accessories of professional and social life. Although they are usually stored in bags or pockets, mobile phones are handled frequently and held

close to the face (Kabir *et al.,* 2009). Global burden of healthcare associated infections (HAI) is on the rise, and contributes significantly to morbidity and mortality of patients. Increase in HAI is concomitantly associated with increase in expenditure for healthcare facilities. Sources of HAI can be endogenous or exogenous. Exogenous sources which can serve as reservoir of

infection are patients, Health care workers (HCW's) inanimate objects like computer keyboards, faucet handles, stethoscopes, wrist watches, mobile phones, and other items present in the immediate vicinity of the patient (Bures *et al.,* 2000).

Cell phones are more problematic compared to other stationary objects (fomites) in that they facilitate inter wards (and possibly inter facility) transmission and are very difficult to rid of pathogens (Famurewa and David, 2009).

There are few reports on the role of mobile phones in the spread of nosocomial infections (Karabay *et al.,* 2007; Borer *et al.,* 2005) and even fewer in a tropical setting (Jayalakshmi *et al.,* 2008).

This study was under taken to determine whether the mobile phones of HCWs are contaminated, since they are used in an environment that harbours nosocomial agents.

Materials and Methods

Place of study

The study was conducted at Ain Shams University Hospital over a period of 3 months from October 2014 to December 2014.

Sample size

The study was conducted over a sample size of 200 mobile phones of health care workers (HCW) which formed the study group (100 mobile phones from doctors "Group A", 80 mobiles from nurses "Group B" and 20 from microbiology laboratory technicians "Group C"). Included those doctors and nurses who had direct contact with patients and an informed consent was taken from the participants.

Data collection

Socio-demographic characteristics of the participants: A self-administered questionnaire was employed to collect information about the socio-demographic characteristics (age, gender and profession), use of mobile phones and habit of cleaning of mobile phones.

Sample collection

Sterile swabs moistened with sterile demineralised water were rotated over the surfaces of the mobile phone by rotating the swabs on the keys, mouthpiece, and ear-piece. Sampled swabs were streaked over Blood agar supplemented with 5% sheep RBCs and MacConkey agar plates. Plates were incubated aerobically at 37°C for 24–48 h. Gram-positive and Gram-negative bacteria were identified as per standard microbiological procedures depending on Gram stain, colony morphology, haemolytic reaction and biochemical reactions [catalase, coagulase (slide and tube) DNAse production]. Gram-negative bacilli were identified by Gram staining, colony morphology, lactose fermentation, and motility, and further biochemical tests like indole production, sugar fermentation and H_2S production, urease production, citrate utilization, and oxidase test. Methicillin Resistant *S. aureus* (MRSA) was confirmed by cefoxitin disc screening and results were interpreted according to CLSI guidelines, 2013 and then sub cultured on Oxacillin Resistant Screening Agar Base (ORSAB).

Results and Discussion

Characteristics of the study participants and their response to the questionnaire about using their mobile phones: among total 200 HCWs included in this study; 65% (130/200) were females while 35% (70/200)

were males. Their age range was 26–55 years with mean (± SD) was 33.1± 5.3. Professionally majority of them were doctors (100/200, 50%). The response given by the participants regarding the use of mobile phones are summarized in table 1. Accordingly 95.5%, 94% and 62% of the participants use mobile phones in the health centre, at home and while attending patients respectively. While 96.5 % had never disinfected their phones and 85.5 % don't think that their phones may carry bacteria. The health care workers participated in this study had used mobile phones for a minimum of 8 months and a maximum of 7 years. Majority of them (150/200, 75%) have been using mobile phones for 4-6 years.

Among the collected 200 samples, 185(92.5%) samples were contaminated while 15 samples (7.5%) were free from aerobic bacterial growth. Group A showed contamination in 92 cases (46%), Group B in 78 cases (39%) while Group C in 15 cases (7.5%). Coagulase negative *Staphylococci* (CONS) the most frequently encountered bacterial agent (72/ 185, 39%) was isolated from the mobile phones of 42.3%, 32%, 53.3% of groups A, B and C respectively. While MRSA was the second bacterial agent recovered (54/185, 29%) from the mobile phones of 32.6%, 27%, 20% of groups A, B and C, respectively. *Acinetobacter sp., E. coli* and *Candida albicans* were isolated from 14%, 7% and 6% of groups' A, B and C mobile phones respectively (Figure 1) (Table 2).

Mobile phones have become an essential commodity in man's day-to-day life. Mobile phones account for more than 88% of all telecom users. It is carried by the doctors during visits to the hospital and is extensively used within the hospital premises including areas like Operation theatres and Intensive care units. If proper infection control practices especially hand hygiene are not followed these devices can serve as a reservoir of infection (Angadi *et al.,* 2014).

In our study 92.5%of the mobile phones were contaminated, similarly Ulger *et al.* (2009) reported that 94.5% of 200 health care workers mobile phones were contaminated with various microorganisms, including nosocomial pathogens, in a study conducted in New York and Israel. In a Sri Lankan study, Gunasekara *et al.* (2009) has reported a contamination rate of 70% of mobile phones of anaesthetists working in the operation theatres. Other studies in India have reported the presence of organisms in 72 and 95% of the mobile phones by Datta *et al.* (2009) and Tambekar *et al.* (2008), respectively.Other studies across the globe have reported contamination of the mobile phonesas a study conducted in Queen Elizabeth hospital in Barbados, West Indies, over 40% of mobile phones of 266 medical staff and students were culture positive Ramesh *et al.* (2008).

Coagulase negative staphylococci may cause a variety of device related (catheter blood stream infections, central nervous system shunt infections and cardiac devices infections) and non-device related infections (endocarditis, osteomyelitis, endophthalmitis and urinary tract infections) (Rogers *et al.,* 2009).

In our study (CONS) was the most frequently encountered bacterial agent (39%) while Srikantha *et al.* (2010) observed that Coagulase negative *Staphylococci* isolated from mobiles were (48%) this difference might be due to difference in sample sizes. We observed that MRSA was the second bacterial agent recovered from (29%). Also Angadi *et al.* (2014) reported that *Staphylococcus aureus* being the only species isolated from mobile

swabs 53.3% of them were resistant to methicillin.

In our study *Acinetobacter* spp., *E. coli* and *Candida albicans* were isolated from 14%, 7% and 6% mobile phones respectively. In other studies, though *Staphylococcus* spp were the predominant species, Gram negative bacteria like *E. coli, Klebsiella spp., Pseudomonas spp, Acinetobacter* which also can cause hospital acquired infections were also isolated from the mobile phones (Patil and Pawar, 2012). Srikantha *et al.* (2010) reported that commonly isolated pathogens from mobile phones were *S. aureus, Escherichia coli, Pseudomonas aeruginosa, Acinetobacter spp.* and *Klebsiella pneumoniae*. Borer *et al.* (2005) observed that there were contaminations of hands and mobile phones only in 10% of their staff who were sampled for once. Tagoe *et al.* (2011) observed that bacterial isolates from cell phones were *Bacillus cereus* being the highest followed by *Proteus mirabilis*, coagulase negative *Staphylococci* and the least organisms sampled were *Citrobacter spp.* and *Shigella* spp.

Table.1 Participants' response for questions related to the use of mobile phones
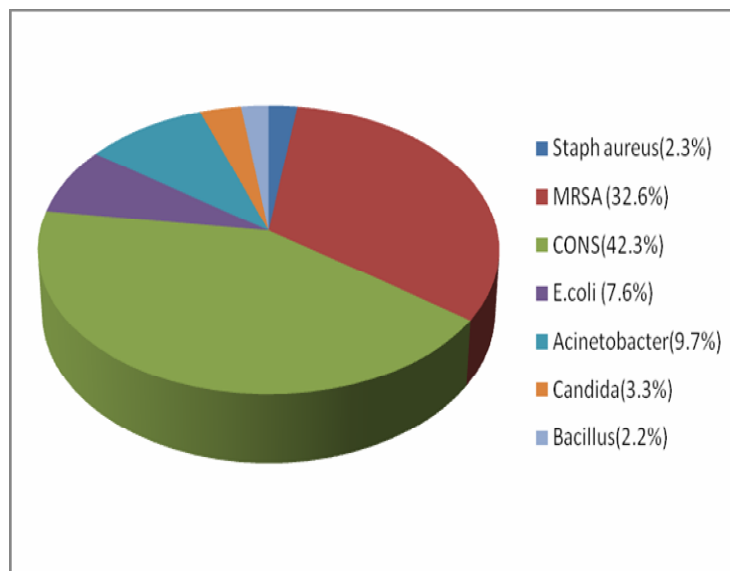
Question	Yes N (%)	No N (%)
Do you use your cell phone in the health centre?	191(95.5%)	9 (4.5%)
Do you use the same cell phone at home?	188 (94%)	12 (6%)
Do you answer phone calls while attending patients?	124 (62%)	76 (38%)
Have you ever disinfected your cell phone?	7 (3.5%)	193(96.5 %)
Do you wash your hands before attending your patients?	157 (78.5%)	43(21.5%)
Do you think cell phones can carry bacteria?	29 (14.5%)	171(85.5%)
Do your families use your cell phone at home?	57 (28.5%)	143 (71.5%)

Table.2 Bacterial agents identified in the study

Subject's group	No. of samples collected	No. of positive samples	Bacterial agent isolated						
			Staph aureus	*Staph aureus* (MRSA)	CONS*	*E. coli*	*Acinetobacter* spp.	*Candida albicans*	*Bacillus* sp.
Group A	100	92	2 (2.2%)	30 (32.6%)	39 (42.3%)	7 (7.6%)	9 (9.7%)	3 (3.2%)	2 (2.2%)
Group B	80	78	1 (1.2%)	21 (27%)	25 (32%)	6 (7.6%)	15 (19.2%)	6 (7.7%)	4 (5.1%)
Group C	20	15	0	3 (20%)	8 (53.3%)	0	2 (13.3)	2 (13.3%)	0
Total	200	185	3 (1.6%)	54 (29%)	72 (39%)	13 (7%)	26 (14%)	11 (6%)	6 (3%)

*CONS: Coagulase negative staph

Figure.1 Isolated microorganisms from all involved groups

Analysis of the questionnaire has shown that only 3.5% of the HCWs wipe mobile phones with disinfectant, 95.5 % 0f the HCWs use their cell phone in the health centre, and that 94% use the same cell phone at home. On the other hand Srikantha *et al.* (2010) analysed questionnaire in his study showing that only 12%of the HCWs wipe mobile phones with disinfectant, While Mark et al.2014 reported that 25% of the individuals in his study stated they never used their phones in work, 52% used their phones 10 times or less in a day, 14% used their phone between 10 and 20 times, and 9%used their phones more than 20 times a day. Intriguingly 25%of individuals questioned stated that they never used their phones in work. Another study reported that restricted usage of the mobile phones during working hours along with proper hand hygiene practices enabled to maintain the mobile phones free of contamination (Jayalakshmi *et al.,* 2008).

The benefits of a mobile phone to the HCW far outweigh the risk of cross-transmission of nosocomial pathogens. Mobile phonesbecome veritable reservoirs of pathogens in the transmission of hospital acquired infections. The prevention of the potential spread of infections through mobile phones needs strict adherence to infection control and precautions such as hand washing (hand-hygiene protocols must include directions for hand washing before and after mobile phone usage) and good hygienic practice among the users.

This hospital acquired infections could also be reduced through education of microbial identification and surveillanceto prevent the possibility of phones as vehicles of transmission of both hospital and community-acquired bacterial diseases. In the future mobile phones could be produced by using protective material against the bacterial contamination. Further studies may be undertaken to target simultaneous sampling of mobile phones, environmental surfaces and hands of the HCWs to identify possible sources of contamination. Periodical sampling of the mobile phones may help to determine whether the organisms are transient or resident.

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