Indian Journal of Dental Sciences.
June 2013 Issue:2, Vol.:5
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www.ijds.in

Original Article

Indian Journal
of Dental Sciences

E ISSN NO. 2231-2293 P ISSN NO. 0976-4003

Cell Phones: A Mechanical Vector For Bacterial Pathogens

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Submission : 27th July 2012
Accepted : 12th March 2013

Quick Response Code

Abstract
Cell phones are increasingly becoming an important means of communication. These cells phones can harbour various potential pathogens and become an exogenous source of nosocomial infection among hospitalized patients and also a potential health hazard for self and family members. A total of 100 cell phones belonging to dentists and patients visiting dental hospital at Sri Sai College of Dental Surgery were screened for bacterial isolates. Sterile swabs moistened with saline were swabbed all the external surfaces of the cell phones and were subjected to culture and sensitivity. Out of total 100 cell phones (50 dentists-50 patients), growth was obtained in 41(51.25%) dentists and 39 (48.75%) patients. Methicillin sensitive coagulase negative was the most commonly isolated organism. The use of cell phones by dentists may serve as potential vehicles (mechanical vectors) for the spread of nosocomial pathogens and the associated nosocomial transmission of pathogens. It is recommended, therefore, that cell phones in the hospital should be regularly decontaminated and dentists should practice a good personal hygiene

Key Words
Cell phones, Microorganism, Nosocomial infections, Dentists

Introduction:

A mobile or cell phone is a long range, portable electronic device for personal telecommunications over long distances. Until the late 1980s, most cell phones were permanently installed in vehicles as car phones. With the advancement in technology however, leading to the miniaturization of circuitry, the vast majority of cell phones are hand held. In addition to the standard voice function of a telephone, a cell phone can support many additional services such as SMS for texting, email, GPRS for the internet and MMS for receiving and sending photos and videos. In many countries cell phones now outnumber landline telephones with many children now owning them. [1]

Today India has 287 million mobile phone users and this accounts for 85% of all the telecommunication users [2].With recent advances in the source of information, use of mobile phones has become indispensable in the hospitals. [3] These can be put in silent mode in intensive care units, Post-operative wards and operation theatres etc. But however they are seldom cleaned and are often touched during or after examination of patients and handling of specimens without proper hand washing. Being conveniently small in size, they are used by doctors for immediate communication during emergencies, in rounds, and even in operation theatres and intensive care units. They may serve as mobile reservoirs of infection allowing the transportation of the contaminating bacteria to many different clinical environments [4] these cells phones can harbour various potential pathogens and become an exogenous source of nosocomial infection[5]. Long lists of nasty bacteria that can cause everything from pimples to meningitis and pneumonia can be found on cell phones. In a study it was discovered the average cell phone is dirtier than either a toilet seat or the bottom of your shoe.[6]

Various objects like stethoscopes, patients file, bronchoscopes and ball point pens have already been reported as vectors for potentially pathogenic microorganisms from health care workers to patients[7], [8], [9], [10].The potential of cell phones as vectors to nosocomial infection has been studied before. These studies reported that the most commonly found bacterial isolate was Coagulase Negative Staphylococcus (CONS) as a part of normal skin flora. Potentially pathogenic bacteria found were Methicillin Sensitive Staphylococcus Aureus (MSSA),Coliforms, Methicillin Resistant Staphylococcus Aureus (MRSA), Corynebacterium spp., Enterococcus faecalis, Clostridium perfringens, Klebsiella spp., Enterobacter spp., Pseudomonas species, Aeromonas species, Acinetobacter and Stenotrophonmonas maltophilia [4],[12],[13]. Bacterial flora on cell phones of dentists may vary in composition, number and antibiotic sensitivity, to that found on cell phones of patients visiting the dental hospitals. This is probably the first study in India that attempts to study the bacterial flora present on cell phones of dentists and to compare it with that of the patients in terms of composition, number and antibiotic sensitivity.

Aims: This study aims to compare the nature of the growth of potentially pathogenic bacteria flora on cell phones in hospital and community.

Objectives:

1) To know the bacterial contamination of the cell phones of dental care

personnel of Sri Sai Dental College.
2) To compare and correlate the bacterial contamination with the use of cellular phones.

Methods and Materials:
Method: The Cross-sectional, study was conducted for three months from October, 2009 to December, 2009 in a dental institution, Sri Sai College Of Dental Surgery, Vikharabad, India. A total of 100 samples from the mobile phones of dentists (n=50) from the hospital and the community (n=50) who volunteered were selected randomly.
Ethics- Ethical clearance was taken from the institutional board of Sri Sai College Of Dental Surgery.

Collection: A sterile cotton swab moistened with sterile normal saline was rolled over all exposed outer surfaces of the cell phones which were used for at least 1 month. Care was taken to make sure that the keypad and all buttons were swabbed since these areas are most frequently in contact with the tips of finger.

1) Dentists n=50:
A total of 50 dentists including doctors from different departments like Community Dentistry, Oral medicine, Periodontics, Prosthodontics, Pedodontics, Oral surgery, Orthodontics, Conservative and Endodontic and Oral pathology were included.

2) Patients n=50:
A total of 50 patients who visited the dental institution were also included to compare with dentist's cell phone.

The samples were collected in the second half of the day from the dentists. These samples after collection were stored in peptone water and transported within a day to department of Microbiology in Durga Bai Deshmukh hospital where they were subjected to culture on blood agar and Mac Conkey agar. After incubation for 24 hours at 37 degree Celsius, the growth obtained was identified on the basis of colonial characters, morphology by gram staining and various bio chemical tests following standard procedures [14]. The isolates were further subjected to Antibiotic sensitivity which was done using Kirby-Bauer disc diffusion method on Mueller-Hinton agar according to Clinical Laboratory Standards Institute antibiotic disc susceptibility testing guidelines [15] .The results obtained from the dentists and patients visiting the dental clinic were then interpreted and recorded.

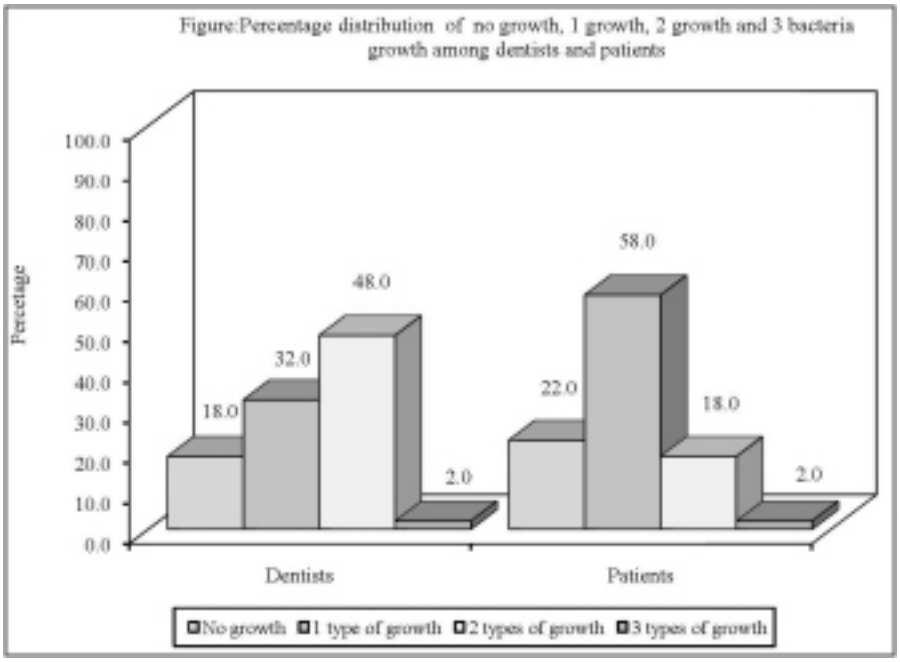
Analysis of Results:
The data was analyzed using SPSS 16.0 version. Comparison between the groups was done using Chi square test and Fischer's exact test. P value less than 0.05 was considered as significant.

Table I: Number of cell phones that showed growth

Growth	Dentist	%	Patient	%	Total
No	9	45.00	11	55.00	20
Yes	41	51.25	39	48.75	80
Total	50	50.00	50	50.00	100
Chi-square=0 .2501df=1p=0.6170, Fisher Exact test, p=0.8030					

Table II: Comparison of microbial growth on cell phones of dentists and patients

Type of organism	Dentist	%	Patient	%	Total
Growth	41	51.25	39	48.75	80
Chi-square=0 .2501 df=1 p=0.6170,Fisher Exact test,p=0.8030					
MSCONS Growth	14	53.85	12	46.15	26
Chi-square= 0.2080 df=1 p=0.6480,Fisher Exact test,p=0.8200					
MSSA growth	20	51.28	19	48.72	39
Chi-square=0.0421 df=1 p=0.8375,Fisher Exact test,p=0.9989					
MRSA growth	7	58.33	5	41.67	12
Chi-square= 0.3790 df=1 p=0.5382,Fisher Exact test,p=0.75961					
E.Coli growth	5	55.56	4	44.44	9
Yates corrected chi-square=0.0001 df=1 p=0.9999,Fisher Exact test,p=0.9999					
Klebsiella growth	6	66.67	3	33.33	9
Yates corrected chi-square=0.4880 df=1 p=0.4846,Fisher Exact test,p=0.4869					
Micrococci growth	4	66.67	2	33.33	6
Yates corrected chi-square=0.1770 df=1 p=0.6737,Fisher Exact test,p=0.6778					
Bacillus growth	5	55.56	4	44.44	9
Yates corrected chi-square=0.0001 df=1 p=0.9999,Fisher Exact test,p=0.9999					
Acinetobacter growth	4	80.00	1	20.00	5
Yates corrected chi-square=0.8420 df=1 p=0.3588,Fisher Exact test,p=0.3622					
Streptococcus Viridans growth	2	100.00	0	0.00	2
Yates corrected chi-square=0.5101 df=1 p=0.4751,Fisher Exact test,p=0.4949					



Graph I: Percentage distribution of no growth, 2 types of organism's growth, 3 types of organism's growth on dentists and patients cell phones.

Results
Of the 100 subjects, 41(51.25%) dentists and 39 (48.75%) patients showed positive growth. The bacterial growth, the type and number of organisms found on the cell phones have been summarized in the **Table I, II, III.** The most common organisms found on cell phones of dentists were Methicillin Sensitive Staphylococcus Aureus (MSSA) (20, 51.28%), Methicillin Sensitive Coagulase Negative Staphylococcus Aureus (MSCONS) (14, 53.85%) followed by aerobic spore bearing bacilli and Streptococcus Viridans; whereas that found in patients were MSSA (19, 48.72%), MSCONS (12, 46.15%) followed by aerobic spore bearing bacilli and no Streptococcus Viridans was found on patients cell phones.

Out of 100 cell phones, 41 cell phones of the dentists (82%) and 39 (78%) patients cell phones showed positive growth. **(Table I and Graph I)**

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Table III: Number of cell phones that showed multiple organisms

Number	Dentist	%	Patient	%	Total
No Growth	9	18.00	11	22.00	20
1 Type Of Growth	16	32.00	29	58.00	45
2 Types Of Growth	24	48.00	9	18.00	33
3 Types Of Growth	1	2.00	1	2.00	2
Total	50	100.00	50	100.00	100
Chi-square= 10.774 df=3 p=0.0130, S					

The various bacteria found on the dentists cell phones were MSCONS 14(53.85%), MSSA 20(51.28%), MRSA 7(58.33%), E.Coli 5(55.56%), Klebsiella 6(66.67%), Micrococci 4(66.67%), Bacillus sps 5 (55.56%), Acinetobacter 4(80%), Streptococcus Viridans 2(100%).

In case of patients MSCONS 12(46.15%), MSSA 19(48.72%), MRSA 5(41.67%), E.Coli 4(44.44%), Klebsiella 3(33.33%), Micrococci 2(33.33%), Bacillus sps 4(44.44%), Acinetobacter 1(20%), Streptococcus Viridans 0(0%). Totally, there were 9 different potentially pathogenic organisms found on cell phones of dentists and 8 different organisms found in the cell phones of patients visiting the dental institution. **(Table II and Graph II)**

In case of cell phones of dentists majority 24 (48%) showed the presence of 2 types of organisms whereas 29(58%) showed growth of one type of organism in dentists cell phones. **(Table III and Graph III)**

Response to questionnaire showed 90% of the dentists use cell phone in the hospital and 50% use it while even attending patients.60% haven't cleaned their cell phones in the past and 70% do not wash their hands before attending to the calls. 96% of the dentists think that their cell phones can carry bacteria while 68% dentists think that their cell phones can act as a vector and can transfer them to their colleagues. **(Table IV)**

From the antibiotic sensitivity testing, it was observed that most of the isolates obtained from cell phones of clinical workers were showing growth of multi drug resistant organisms (Genatmicin, Cephalothin and Amoxicillin)

Discussion:

In the world over, microbiological standards in hygiene are prerequisite for a healthy living. Out of total 100 cell phones growth was obtained in 80%cell phones 41 (82%) dentists and 39 (78%) patients visiting the dental institution **(Table 1).** This study shows higher percentage when compared with the findings of the study by Usha Arora, Pushpa Devi, Aarti Chadha, Sita Malhotra, in Amritsar which showed positivity of 65% [13]. This might be because of more frequent usage of these devices by dentists in our institution. Out of the total organisms isolated Methicillin Sensitive Staphylococcus Aureus (MSSA) was the most common organism. This goes well with the results of study at Manipal conducted by Kiran Chawla, Chiranjay Mukhopadhayay et al which showed the highest growth of staphylococcus aureus. [14] This is probably the first study from India where bacterial load and existence of potential pathogens on cell phones of dentists and patients visiting the dental institution of Sri Sai College of Dental Surgery were compared. This study indicates that the carriage of pathogens on the cell phones of dentists is significantly higher than that of patients. The higher rates of contamination of cell phones in dentists in this study might be due to the influence of various factors like general hygiene and hand washing practices of the dentists, disinfection practices, frequency of use and cleaning of cell phones etc. The kind of bacterial flora grown depend on the conditions under which the plates are incubated. Here, the plates were incubated only under aerobic conditions.

In a study by Kiran Chawla et al it was found that 18% cell phones was dentists showed no growth , 32% showed one bacterial species , 48% showed 2 different species and 2 % showed 3 or more different species.[14] In a study by Gholamreza Sepehri, Nooshin Talebizadeh et al, Iran it was found that 49% of phones grew one bacterial species, 34% two different species, 11.5% three or more different species and no bacterial growth were identified in 5.5% of phones.[16]

The susceptibility to commonly used antimicrobials was similar for mobile phones of dentists and patients. However, we observed a relatively high resistance rate to some of the commonly used antimicrobials (25% for amoxicillin) which is clinically important. The high resistance rate to commonly used antimicrobials has been reported by other investigators too (Gholamreza Sepehri, Nooshin Talebizadeh et al, Iran). [16]

This is a well-known fact that organisms like staphylococcus aureus and coagulase negative staphylococcus resist drying and thus can survive and multiply rapidly in the warm environments like cell phones. MSSA and MSCONS that were mainly isolated from cell phones of dentists performing surgeries or handling acutely ill patients and could transfer this MSSA to the patients. [14]

In a study on public telephones conducted by Tunc K, Olqun U [17] twelve different types of bacteria were found on the surface of telephones. The level of bacterial contamination for the telephone mouthpiece was increased to its highest point in October from its lowest value in August. It was also found that the microbial contamination of mouthpiece was about twice the contamination of earpiece.

Similarly, in another recent study by Rafferty KM, Pancoast SJ [11] determined the contamination rate of the healthcare workers' (HCWs') mobile phones and hands in operating room and ICU suggested 94.5% of phones to have the evidence of bacterial contamination with different types of bacteria. The gram negative strains were isolated from mobile phones of 31.3% and the Ceftazidime resistant strains from the hands were 39.5%. S. aureus strains isolated from mobile phones of 52% and those strains isolated from hands of 37.7% were Methicillin resistant.

Conclusion:

It is thus concluded that in comparison to patients visiting dental hospital, the carriage rate on cell phones of dentists was higher. Thus, cell phones carried by dentists in the hospital may serve as mechanical vectors for transmission of multi drug resistant organisms to the patients and even to their family members. As restriction or prohibition of such devices may prove impractical, strategies for preventing nosocomial transmission is needed. Regular hand washing prior to examination of patients or decontamination of cell phones with isopropyl alcohol disinfectant wipes should be done to prevent nosocomial infections.

Recommendations:

Control measures are quite simple and can include engineering modifications, such as the use of hand free mobile phones, cleaning and disinfection of appropriate mobile surfaces, and washing hands with a soap/disinfectant. In general, the medical facility's infection control staff can advise for facility's routine control practices in hospitals 18. Observance of these simple control procedures can potentially decrease morbidity and mortality for patients and reduce medical care costs for hospitals and care giving organizations.

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Source of Support : Nill, Conflict of Interest : None declared

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