

# Cellular Telephone as Reservoir of Bacterial Contamination: Myth or Fact

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## ABSTRACT

**Objective:** To assess bacterial contamination of cellular telephone of dental care personnel, and to determine factors contributing to their contamination.

**Materials and Methods:** A descriptive, cross-sectional study was conducted, which included 300 people using a cellular telephone. The study group (hundred in each group) comprised of Dental Health Care Personnel (DHCP), In-Hospital Personnel (IHP) and Out-Hospital Personnel (OHP) of a dental college cum hospital. Swab was wiped along the front and all sides of cellular handset and it was incubated in glucose broth. The swab was subplated onto growth media plates made with half MacConkey's agar and half blood agar and allowed to incubate for 48 hours at 37°C. Isolates were tested for antimicrobial susceptibility.

**Result:** The analysis of presence or absence of microorganisms in the DHCP, IHP and OHP group showed no pyogenic growth in 28%, 31% and 41% cases respectively, the distribution of which was not significant ( $p > .05$ ). Among non potential pathogens, spore bearing gram positive bacilli were seen in 20 cases of DHCP group, 16 cases of IHP group and 17 cases of OHP group; the distribution of which was not significant ( $p > .05$ ). Among potential pathogens, significant differences were observed in the distribution of growth of *Enterobacter* ( $p < .001$ ), *Pseudomonas* species ( $p < .05$ ), *Acinetobacter* bacteria ( $p < .05$ ) and Methicillin-resistant *Staphylococcus aureus* (MRSA) bacteria ( $p < .001$ ) between the participants of different groups.

**Conclusion:** Results of this study showed that fomites such as cellular telephones can potentially act as "Trojan horses", thus causing Hospital-Acquired Infections (HAIs) in the dental setting.

**Keywords:** Hospital acquired infection, Dental Health Care Personnel (DHCP), Health Care Worker (HCW)

## INTRODUCTION

HAIs are an increasing global concern for patient safety. They affect more than 25% of the total health care admissions in developing countries [1] with their potential sources, consisting of patients' own flora; inanimate hospital objects; medical personnel; or, less often, the visitors. However, most of the nosocomial infections occur because of the fact that health care workers (HCWs) do not practise correct hygiene regularly [2].

Cellular telephones which have become an indispensable part of our lives are gaining importance in the healthcare setting as well, since they are essential for quick and convenient access to laboratory and imaging results, for consultations, for telemedicine and for life-threatening emergencies [3]. The use of cellular telephones is also associated with adverse effects such as risk of motor vehicle crashes [4], different malignancies [5]. Although cellular telephones act as a quick and convenient tool for peer consultations, they may interfere with procedures such as obtaining histories and physical examinations. Experts indicate that in 2005, there were more than 6.7 billion wireless telephone users worldwide. Today, it has been assumed that almost every health care professional has a private cellular telephone, which highlights its importance in the medical field [6].

Mobile phones, like many everyday objects such as telephones and computer keyboards, harbour bacteria. However, being 'mobile', they are stored in bags or pockets, are handled frequently, and are held close to the face. In other words, they come into contact with more parts of our body and a wider range of bacteria than toilet seats [7].

The phones contain more skin bacteria than any other object; this could be due to the fact that this type of bacteria multiply at high temperatures and our phones are perfect for breeding these germs, as they're kept warm and cozy in our pockets, handbags and brief cases. These bacteria are toxic to humans, and can cause infections if they get an opportunity to enter the body. Their apparently frequent

use by DHCP makes cellular telephones a potentially perfect vehicle for nosocomial transmission of pathogens.

Since the use of cellular telephones by DHCP has not been adequately studied, the present study was carried out at a dental college cum hospital, to assess bacterial contamination of cellular telephones of dental care personnel, and to determine factors contributing to their contamination.

## MATERIALS AND METHODS

The study protocol was approved by the ethical committee of the dental college. A descriptive, cross-sectional study was conducted at Sri Guru Ram Das (SGRD) Dental College, Amritsar, Punjab, India; between September 2012 to March 2013; and it included 300 people using cellular telephones. The study group (100 in each group) comprised of DHCP, IHP and OHP of a dental college cum hospital. The DHCP group in the study included doctors, post-graduate students, interns, final year dental students; who were posted in specific departments with heavy patient contact (15-20 patients/day). The IHP group comprised of individuals who did not come in direct contact with patients and they included first and second year dental students. The OHP group included patients and their relatives.

Samples were obtained from the cellular telephones of the study group by an investigator using a consistent procedure. The investigator wore sterile gloves while cultures of cellular telephones were obtained. A sterile cotton swab was wiped along the front and all sides of handset, with slight rotation several times. Swab was immediately incubated in glucose broth (transport media). The swab was subplated onto growth media plates made with half MacConkey's agar and half Blood agar and allowed to incubate for 48 hours at 37°C.

All the samples were processed at the Clinical Microbiology Laboratory of the hospital. Culture results were measured as mean number of colony-forming units (CFUs). Isolated microorganisms

Pathogen	No. of cellular telephones with isolates, by group (%)		
	DHCP (n=100)	IHP (n=100)	OHP (n=100)
No Pyogenic Growth	28	31	41
Pyogenic growth	72	69	59

**[Table/Fig-1]:** Presence/ absence of micro organisms isolated from cellular telephone of study participants

Pathogen		DHCP (n=100)	IHP (n=100)	OHP (n=100)	Pearson Chi-square	p-value
No pyogenic Growth		28	31	41	4.170	.124
Non-potential pathogens	Spore bearing gram positive bacilli	20	16	17	.596	.742
	Coagulase negative Staphylococci	27	35	59	23.04	<.001**
Potential Pathogens	Enterobacter Growth	14	13	0	14.89	.001**
	Pseudomonas Species	8	0	6	7.792	.020*
	Methicillin Sensitive Staphylococci aureus (MSSA)	8	9	4	2.151	.341
	Methicillin Resistant Staphylococci aureus (MRSA)	29	4	0	50.46	<.001*
	Acinetobacter	2	0	6	7.192	.027*

n= Total number of subjects examined, \* p<0.05; significant at 5%; \*\* p< 0.001; highly significant

**[Table/Fig-2]:** Distribution of microorganisms isolated from cellular telephone of study participants

were identified on basis of gram staining, morphology, catalase and oxidase reactions, and all isolates were allocated to the appropriate genera. A slide coagulase test differentiated Staphylococcal isolates into Staphylococcus aureus and coagulase-negative Staphylococci (CoNS). Gram-positive cocci (GPC) were tested for catalase and coagulase reactions (Staphaurex, Murex Diagnostics Limited, Hartford, England). Catalase-positive, coagulase-positive GPC were identified as Staphylococcus aureus and they were further tested for antibiotic sensitivity, including methicillin resistance. Antibiotic sensitivity was assessed using the Kirby-Bauer disc diffusion method on Mueller-Hinton agar according to Clinical Laboratory Standards Institute antibiotic disc susceptibility testing guidelines [8].

The data collected was first visualized to confirm their normal distribution. The resulting data was analyzed using SPSS, version 10 and Epi-Info 6.04 d software. Following this, descriptive

Pathogen		DHCP-IHP		DHCP-OHP		IHP-OHP	
		Pearson Chi-square	p-value	Pearson Chi-square	p-value	Pearson Chi-square	p-value
No pyogenic Growth		.216	.642	3.739	.053	2.170	.141
Non-potential pathogens	Spore bearing gram positive bacilli	.542	.462	.298	.716	.036	.849
	Coagulase negative Staphylococci	1.496	.221	20.89	<.001**	11.56	<.001**
Potential pathogens	Enterobacter Growth	.043	.836	15.05	<.001**	13.91	<.001**
	Pseudomonas Species	8.33	.004*	.307	.579	6.18	.013*
	Methicillin Sensitive Staphylococci aureus (MSSA)	.064	.800	1.41	.234	2.06	.152
	Methicillin Resistant Staphylococci aureus (MRSA)	22.68	<.001**	33.91	<.001**	4.08	.043*
	Acinetobacter	2.02	.155	2.08	.149	6.18	.013*

n=Total number of subjects examined; \* p<0.05, significant at 5%; \*\* p< 0.001, highly significant.

**[Table/Fig-3]:** Significance of distribution of microorganisms between the groups

statistics including the mean values and standard deviations, 95% confidence intervals, interquartile ranges (25th and 75th percentiles), were calculated for each variable. Comparisons of data sets were performed using the Student's t-test; p≤0.05 was considered as statistically significant.

## RESULTS

In the present study, amongst the study participants, the cellular telephones were assessed for the presence/ absence of micro organisms, and it was seen that in the DHCP, IHP and OHP groups, 28%, 31% and 41% cases showed no pyogenic growth respectively [Table/Fig-1]; the distribution of which was not significant (p>.05) [Table/Fig-2]. Positive growth of micro organisms was further categorized into potential and non potential pathogens. Among non potential pathogens, spore bearing gram positive bacilli were seen in 20 cases of DHCP group, 16 cases of IHP group and 17 cases of OHP group; the distribution of which was not significant (p>.05) CoNS was seen in 27 cases of DHCP group, 35 cases of IHP group and 59 cases of OHP group; the distribution of which was highly significant (p<.001).

Among potential pathogens, significant differences were observed in the distribution of growth of Enterobacter (p<.001), Pseudomonas species (p<.05), Acinetobacter bacteria (p<.05) and MRSA bacteria (p<.001) between the participants of different groups. No significant distribution was seen for MSSA bacteria (p>.05) [Table/Fig-2].

The significance of each micro organism was also calculated for differentiating the distribution between DHCP-IHP group, DHCP-OHP group and IHP-OHP group [Table/Fig-3].

On comparing DHCP-IHP group, it was seen that significant differences were present among Pseudomonas (p<.05) and MRSA bacteria (p<.001), while other bacteria showed non significant results (p>.05). The DHCP-OHP group showed significant differences among CoNS (p<.001), Enterobacter (p<.001) and MRSA bacteria (p<.001). However, the other bacteria showed non significant differences (p>.05) in the same group. On evaluation of IHP-OHP group, it was seen that spore bearing gram positive bacilli and MSSA bacteria showed no significant differences (p>.05), while the rest of the bacteria showed significant differences (p>.05).

For the absence of pyogenic growth, non significant results were seen during differentiation of the distribution between DHCP-IHP group, DHCP-OHP group and IHP-OHP group (p>.05) [Table/ Fig-3].

## DISCUSSION

The world over, maintaining hygiene standards is a prerequisite for healthy living. It is not uncommon however, to observe shift in hygiene practices that deviate from normal standards of hygiene in both the developing and the developed world. Medical personnel

use their cellular telephones excessively while in the hospital; hence, the threat of contamination with potential pathogens is a valid concern [9].

The upsurge of diseases such as AIDS and the recrudescence of diseases such as tuberculosis and Hepatitis B, C, and D have made it essential that strict infection control be accomplished and maintained [10]. The possibility of transmission of nosocomial pathogens by electronic devices used in the hospitals has been previously reported by Ulger et al., [11] some of which were epidemiologically important drug-resistant pathogens. Several reports have documented the contamination of mobile phones among HCWs [12-14].

Almost all the cellular telephones sampled in the three groups at our dental college cum hospital were contaminated, mainly by pyogenic organisms. In the present study, 27 cellular telephones of the DHCP group were contaminated with CoNS, and 20 telephones were contaminated with spore bearing gram positive bacilli which are non potential pathogens, while 61 telephones had potential pathogens. In a study conducted by Singh et al., [10], the use of mobile phones by dental faculty and trainees involved in direct patient care not only demonstrated a high contamination rate with bacteria, but more importantly with nosocomial pathogens (*Staphylococcus aureus*, *Acinetobacter*, *Pseudomonas*, *Staphylococcus citreus*). Studies have shown that 30 percent of nosocomial infections in the ICUs are associated with *Acinetobacter* spp. [14]. A similar study done in Israel identified multidrug-resistant *Acinetobacter baumannii* on the hands, cell phones of HCWs, and patients admitted to the ICU. Following that study, the use of cell phones in patient care areas has been banned in the concerned hospital [15].

Potential pathogens were seen in 26 and 16 cellular telephones in the IHP and OHP groups respectively, which were comparatively very low as compared to that in the DHCP group, highlighting the fact that personnel who had direct contact with the patients and increased atmospheric bacterial contamination during routine dental activity could be probable factors for the increased bacterial contamination. Another possible reason for this could be the negligence on the part of the dental personnel in using cellular telephones while performing dental procedures.

Nosocomial infections have become a potential threat in health care setups. The source of infection may be exogenous, such as from the air, dental equipment, hands of surgeons, and other staff, or endogenous, such as the from bacterial flora at the operative sites [16]. Colonization of potentially pathogenic organisms on various objects such as pagers, personal digital assistants, hands, and mobile phones has been reported by various authors [10,11]. The personal work tools such as stethoscopes, ball point pens which are not included in routine hospital cleaning, have also been proved to be possible sources of contamination [17]. These objects have been suggested as vectors or possible vectors for transmission of nosocomial pathogens from HCWs to patients.

The importance of hazard of cross-infection from contaminated and inadequately sterilized items and surfaces is being increasingly highlighted in dental practice. Although the interaction of bacteria suspended in air with surfaces has not been well studied, it is known that airborne microorganisms eventually settle onto surfaces in the environment [18]. Once deposited on surfaces, many infectious agents can survive for extended periods, unless they are eliminated by disinfection or sterilization procedures [19]. Given the volume of aerosols and spatter produced during dental treatment, the contamination of surfaces in the dental operator is of particular concern, as surfaces containing viable organisms become potential reservoirs for infection [20]. The cellular telephones which are used in close proximity to such surfaces have an increased risk of being cross-contaminated with such organisms.

The distribution of micro organisms between the groups was calculated, with significant differences between the groups on

comparing MRSA bacteria, highlighting the presence of wide range in distribution of the same. Organisms which were non significant in distribution between the three groups showed uniformity of their presence, irrespective of the environment which they were subjected to.

To reduce bacterial colonization on the cellular telephones of dental care personnel, staff education, use of dental gloves, handwashing, use of alcohol disinfectant wipes, use of alcohol-chlorhexidine wipes, and consideration of the restrictions regarding the use of cellular telephones in certain high risk areas, have been recommended [12,21-23]. Similarly, these precautions may be adopted for the phones of patients, patients' companions, and visitors.

Dental gloves which protect the dental care personnel from being infected by the patients, is not a foolproof method for containing contamination. Use of cellular phones by HCWs with gloved hands is not uncommon, leading to increased tendency of developing nosocomial infections. Use of gloves does not eliminate the purpose of hand washing, as gloves may become contaminated due to punctures, while in use. Research has found that prolonged use of gloves and the use of products like disinfectants, composite resins, and alcohol may increase the permeability of these gloves [24]. The Canadian Dental Association recommends that hands be washed with germicidal soap before and immediately after the use of gloves [25]. Active Pharmaceutical Ingredients (APIC) guidelines consider hand-washing as the single most important intervention for preventing transmission of micro organisms from hands of health care personnel [26]. Therefore, emphasis should be placed on compliance with hand-washing guidelines.

Today, cellular telephones are important tools for HCWs. Since restriction on the use of cellular telephones by HCWs in hospitals is not a practical solution, it is recommended that HCWs should practice increased adherence to infection control precautions such as hand hygiene. In addition, HCWs should be informed that these devices may be sources for transmission of Health Associated Infection (HAI). Rather, it has been suggested that routine cleaning of cellular telephones may be effective for reducing micro organisms and for controlling cross infections.

## CONCLUSION

The present study suggests that personnel who have direct contact with patients have increased pathogenic contamination and fomites such as cellular telephones can potentially act as "Trojan horses" in causing HAIs in the dental setting.

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