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Original Article

Microbiology Section

Cell Phones- The New Vehicle of Bacterial Transmission-Current Scenario

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ABSTRACT

Introduction: Nosocomial infections are a major concern in any hospital setting. Widespread utilisation of cell phones among health care professionals just like in the general population poses a potential threat of rampant spreading of Methicillin-Resistant *Staphylococcus aureus* (MRSA).

Objectives: To study the bacterial colonization on mobile phone surfaces of heath care professionals and community residents and to compare the prevalence of MRSA on the surface of mobile phones of health care professionals and of community residents.

Materials and Methods: A cross sectional study was carried out among 200 cell phone user by taking swabs from the surface of the cell phones. 100 swabs from cell phones were taken from health care professionals in a tertiary care teaching hospital and another 100 swabs from cell phones were taken from the residents of the surrounding communities. Aerobic bacteria were identified as per standard microbiological procedures.

Results: Aerobic bacterial growth on cell phones was observed in 64% of community residents and 43% of health care professionals. *Staphylococcus aureus* colonization was seen in 10 % of the health care professionals and in 4% of the community residents. Almost 60 % of the hospital isolated *Staphylococcus aureus* were methicillin resistant as compared to methicillin sensitive *Staphylococcus* growth in the community residents' cell phones.

Conclusion: Practice of disinfecting cell phones was lacking both in health care professionals and community residents. MRSA and MDR *Pseudomonas* were found in hospital subjects, which hold a threat of nosocomial infection. *Escherichia coli* and *Enterococci* were found in the community resident, thereby showing their lack of following proper hand hygiene.

Keywords: Bacterial colonization, Community residents, Health professional, Mobile phone

INTRODUCTION

Staphylococcus aureus normally gets transmitted via close skin contact. Inanimate objects in the hospital settings are known to be contaminated with such skin commensals1. However, in a society that is getting increasingly dependent on cell phones, it has become the new "vehicle of transmission of diseases" [1].

There is evidence to suggest that cell phones are ideal for colonization of bacteria because of higher temperature and humidity [1]. Due to increasing usage of cell phones by health care professionals for quick and easy communication [2], the spread of Staphylococcal infection among health care professionals and patients are on a rise. It is difficult to treat when the bacteria is highly resistant to commonly used antibiotics, e.g. Methicillin-Resistant *Staphylococcus aureus* (MRSA).

Staphylococcus, apart from targeting organs like skin, blood, and bones, also may cause toxic shock syndrome, which is an illness caused by its toxins [3]. It is difficult to treat when the bacteria is highly resistant to commonly used antibiotics e.g. Methicillin-Resistant *Staphylococcus aureus* (MRSA).

Of the different types of infectious *Staphylococcus aureus*, MRSA is a pathogen that is very difficult to treat and has high risk of spreading among patients. MRSA was initially almost confined to hospitals [4] and this was referred to as Hospital Acquired-MRSA. On the other hand, a recent study [3] showed that MRSA was spreading in nearby communities, which is known as Community Acquired- MRSA. Both are clinically and biologically different [3]; but, both are contagious and can spread via cell phones. Widespread utilization of cell phones among health care professionals just like in the general population poses a potential threat of rampant spreading of MRSA.

In a study [5], it was shown that usage of alcoholic disinfectants eliminated bacterial contamination in 98% of cell phones. It is a simple measure that should be incorporated into daily lifestyle to prevent potential spread of pathogenic bacteria within the hospital and community settings. There are few studies about the bacterial colonization on cell phones of health care professionals and there are fewer studies among community residents. Hence, this study was taken to assess and compare bacterial colonization on the cell phone surfaces from the health care professionals and the community

residents and also to assess the awareness and practice of disinfection of cell phones among them. The purpose of the study is to demonstrate the types of bacterial colonization found on cell phones' surfaces, especially MRSA. Thereby show the potential threat of the spreading of MRSA in both the hospitals and community via cell phones.

OBJECTIVES

1. To study the bacterial colonization on cell phone surfaces of heath care professionals and community residents.

2. To compare the prevalence of Methicillin-Resistant *Staphylococcus aureus* on the surface of cell phones of health care professionals and of community residents.

3. To assess the awareness of bacterial colonization on cell phone surfaces among the study groups.

4. To assess the practice of hand hygiene andpractice of cell phone hygiene among the study groups.

MATERIALS AND METHODS

It is a cross sectional study design (Comparative study). A total of 200 cell phones were analysed by taking swabs from the surface of the cell phones. 100 of these cell phones were taken from health care professionals in a tertiary care teaching hospital (SRM Hospital) and another 100 were taken from the residents of the surrounding communities (Kattankulathur in Kanchepuram District).

Inclusion Criteria

Cell phones swabs of health care professionals in a tertiary care teaching hospital and swabs of residents of the surrounding villages, who had not visited hospitals for a period of one year.

Exclusion Criteria

Attenders and patients are excluded from the hospital swab collection. Children, who are below 10 years of age, were not included in the community swab collection. Anaerobic and fungal cultures were not done.

Study duration: Two months (September to October 2012).

Surface samples were taken from mobile phones of health care professionals from a tertiary care teaching hospital and the surrounding communities' residents for a period of two months, after obtaining consent. Surface samples were taken from mobile phones of health care professionals from a tertiary care teaching hospital and the surrounding communities' residents for a period of two months, after obtaining consent. Moist sterile swab were wiped over the mobile phone surfaces to collect any bacteria if present and brought to microbiology laboratory. Blood agar and MacConkey agar plates (Hi-Media Company Limited, India) were used to streak the sampled swabs. The streaked culture plates were incubated aerobically at 37°C for 24 - 48 hours for bacterial growth. Aerobic bacteria which grew were isolated and identified as per standard microbiological procedures.

The identification of Gram-positive cocci were done by Gram staining, colony morphology on the culture plates, and the type of hemolysis. Growth of *Staphylococci* was confirmed based on catalase, slide & tube coagulase, and utilisation of glucose and mannitol. Similarly, Gram-negative bacilli were identified by Gram staining, colony morphology, lactose fermentation, and motility, and confirmed by biochemical tests like indole production, triple sugar fermentation and H_2S production, urease production, citrate utilisation, and MR-VP test for the nature of fermentation. The non fermenters were identified using catalase and oxidase tests, Non lactose fermentation on MacConkey agar, growth at 42°C, and confirmed by biochemical tests of dextrose utilization, and nitrate reduction. Finally, antibiotic susceptibility testing for all the identified bacteria were done by Kirby-Bauer Disc diffusion method as per Clinical Laboratory Standard Institute (CLSI) [1].

Data Collection Procedures

Data of participants' socio-demographic profile like age, sex, occupation and the practice of hand hygiene and cell phone disinfection were collected using pre-tested structured questionnaire after getting participants consent.

Ethical Consideration

Ethical clearance for the study was obtained from the institutional ethical committee.

Ethics clearance number: 470/IEC/2013

OBSERVATIONS AND RESULTS

In this study, samples from cell phones were taken from 100 health care professionals and 100 residents of nearby communities. Among the 100 health care professionals, 55 were males and 45 were females, whereas in community residents, 46 were males and 54 were females [Table/Fig-1].

Among the health care professionals, 73% were aware about bacterial colonization on cell phones, whereas, only 5% of the community residents were aware. This difference in proportion was found to be statistically significant (p=0.001). Proper hand hygiene measures were followed by 92% of the health care professionals and 86% of the community residents. The difference was not statistically significant. Only 11% of the health care professionals disinfect their cell phones (though 73% were aware) and 5 % of community residents who were aware disinfect their cell phones. The difference was not significant. It was observed that 96% of the health care professionals carry cell phones in hospital, whereas, only 82% of community residents carry cell phones to hospitals. The difference is found to be highly significant (p=0.002). Among the community residents, 82% of the community residents carry their cell phones and 75% of them use their cell phones in the hospital. On the other hand, 96% of the health care professionals carry cell phones, but only 71% use them in hospital premises [Table/Fig-2].

Among the 16 study subjects who disinfect their cell phones, majority of the subjects disinfect once in three months or even

less frequently. The frequency seems to be better among health care professional. By analysing the bacterial growth on cell phones among the study subjects, it was observed that the growth was seen in 64% of community residents as compared to 43% of health care professionals. There was a statistically significant (p=0.003) difference. The growth of normal commensals was also included in this study [Table/Fig-3].

Normal commensals were commonly present on the cell phones of both, health care professionals and community residents. MRSA and *Pseudomonas* were detected more in the hospital subjects. Of the five *Pseudomonas* isolated from the health care professionals, four were found to be multi-drug resistant. On the other hand, *Escherichia coli* and *Enterococci* were found to be more in the community residents and were sensitive to the commonly used antibiotics. This is found to be statistically significant (p=0.008) [Table/Fig-4].

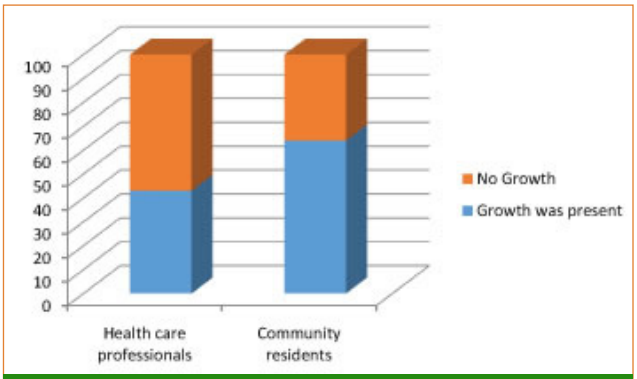
Staphylococcus aureus colonization was seen in 10% of the health care professionals and in 4% of the community residents. Almost 60 % (n=6) of the hospital isolated *Staphylococcus aureus* are methicillin resistant as compared to *Staphylococcus aureus* isolated from the community which were sensitive to the commonly used antibiotics, but this was not statistically significant (Fisher exact probability test, 2=2.11, p=0.069). This may due to the small sample size [Table/Fig-5].

Age group	Health care professionals		Community residents	
	Male (%)	Female (%)	Male (%)	Female (%)
10-19	0	0	3 (6.6)	1 (1.9)
20-29	37 (67.3)	42 (93.3)	15 (32.6)	16 (29.6)
30-39	8 (14.6)	3 (6.7)	7 (15.2)	20 (37.0)
40-49	2 (3.6)	0	7 (15.2)	9 (16.7)
50-59	1 (1.8)	0	7 (15.2)	7 (12.9)
60-69	7 (12.7)	0	7 (15.2)	1 (1.9)
Total	55 (100)	45 (100)	46 (100)	54 (100)

[Table/Fig-1]: Age and sex distribution of study subjects

Statement	Health care professionals (n=100)	Community residents (n=100)	Chi-square	p-value
Awareness of bacterial colonization	73	5	97.18	0.001
Practice of proper hand hygiene	92	86	1.84	0.175
Practice of disinfection of Phones	11	5	2.45	0.118
Carrying cell phones in hospital	96	82	10.01	0.002
Usage of cell phones in hospital	71	75	0.41	0.524

[Table/Fig-2]: Awareness of bacterial colonization and Practice of hygiene among the study subjects



[Table/Fig-3]: Bacterial growth on cell phones among the study subjects

Bacteria	Health care professionals	Community residents	Chi-square	p-value
Coagulase negative *Staphylococcus*	40	64	18.89	0.008
Methicillin sensitive *Staphylococcus aureus*	4	4		
MRSA	6	0		
Pseudomonas aeruginosa	5	2		
Escherichia coli	1	4		
Klebieslla	1	1		
Gram Positive bacilli	4	19		
Enterococci	0	1		

[Table/Fig-4]: Organism present on cell phones of health care professionals and community residents

Antibiotics	*Staphylococcus aureus*			
	Hospital (n=10)		Community (n=4)	
	Sensitive	Resistant	Sensitive	Resistant
Ampicillin	4	6	4	0
Cefoxitin	4	6	4	0
Erythromycin	10	0	4	0
Clindamycin	10	0	4	0
Cefuroxime	4	6	4	0
Ciprofloxin	10	0	4	0
Cotrimoxazole	7	3	2	2
Linezolid	10	0	4	0
Vancomycin	10	0	4	0

[Table/Fig-5]: Antibiotics susceptibility test of the isolated *Staphylococcus aureus*

DISCUSSION

In the present study analysis of colonies on the cell phones showed 73% of health care professionals were aware about bacterial colonization on cell phones; whereas, only 5% of the community residents were aware. This result is in contrast with the study done by Mukhopadhyay C. et al., [6], in which 57.5% of the community was aware of the presence of bacterial colonization and 77.5% of the health care professionals were aware. Proper hand hygiene measures were followed by 92% of the health care professionals and 86% of the community residents.The results are higher than the study done by Mukhopadhyay C. et al.,[6], where only 80% of health care professionals followed proper hand hygiene.

Despite 73% of health care professionals were aware, only 11% of the health care professionals disinfect their cell phones; whereas 5% community residents were aware and disinfect their cell phones. This is contradictory to the study done at Queen Elizabeth Hospital, Barbados by Ramesh J et al., [7], where 47% of health care professionals disinfect their cell phones.

Among the study subjects who disinfect their cell phones, majority disinfect once in three months or even less frequently. The frequency seems to be better among health care professionals compared to community residents. The frequency of disinfecting cell phones seems to be better among health care professionals in the study done by Ramesh J et al., [7], in which, the health care professionals disinfect their cell phones once or twice a week. It signifies the necessity of a protocol for proper hygiene and disinfection of cell phones. This may minimise the contamination of cell phones. In a study by Arora U. et al., [5], the use of 70% isopropyl alcohol wipes eliminates bacterial contamination in 98% of cell phones.

In our study, 96% of the health care professionals carry cell phones in hospital, whereas only 82% of community residents carry cell phones to hospitals. However, Ramesh J. et al., [7] study showedonly 70% of health care professionals carry their cell phones in the hospital. In this study, although 96% of health care professionals carry cell phones in hospitals, only 71% use them in the hospital premises; whereas, 82% of the community residents carry their cell phones and 75% of them use their cell phones in the hospital. Among the 70% of health care professionals who carry their cell phones in Barbados study [7], 98% of them use their cell phones in the hospital. Cell phone contamination may be reduced, if cell phone usage is reduced in the hospital. This is impractical, since cell phones have become an integral part of daily lifestyle and medical profession. Besides restricting cell phone use, other measures may be taken, e.g. following the protocol for proper hand hygiene.

Studies have been reported from India (Khivsara et al., [8], 2006; Tambekar and Dahikar, 2006 [9]), Israel and Spain (Meltzer, 2003 [10]), that cell phones is involved in the transmission of infections in the healthcare systems.

Borer et al., 2005 [11]; Brady, 2006 [12]; Dubik, 2006 [13] reported threatening infection due to pathogens could be acquired from health care professional's cell phones, which is a great concern.

Derbyshire and Burgess, 2006 [14]; Bhattacharya, 2005 [15] reported increased rate of hospital infection with use of cell phones [16].

In this study, both the hospital and community, normal commensals were the most prominent bacterial growth on the cell phones. MRSA and *Pseudomonas* were detected more in the hospital subjects, whereas, *Escherichia coli* and *Enterococci* were found to be more in the community residents. The presence of *Pseudomonas* correlates with the results obtained in the Tankhiwaleet al., [16] study and presence of MRSA correlates with the results obtained in the Srikanth P et al., [1] study. The presence of multi- drug resistant *Pseudomonas* in other studies suggests that new studies should be conducted on presence of multi-drug resistant *Pseudomonas* in cell phones of health care professionals.

10% of the health care professionals' cell phones had *Staphylococcus aureus* colonization and only 4% of the community residents' cell phones. There was almost 60% of the hospital isolated *Staphylococcus aureus* are methicillin resistant as compared to drug sensitive *Staphylococcus* growth in the community residents' cell phones. The presence of MRSA colonization among health care professionals' cell phones correlate with the results obtained in the study done by Srikanth P et al., [1], where there was 71.43% among the *Staphylococcus aureus* colonization. The presence of *Staphylococcus aureus* colonization on cell phones indicate that there is a possibility of *Staphylococcus aureus* spreading to cell phone users and others from cell phones. In addition, presence of MRSA depicts the possibility of multi-drug resistant bacteria on cell phones which may spread.

CONCLUSION

MRSA that was isolated from the cell phones of health care professionals is 6% and none of the community residents' cell phones showed MRSA. Educating and sensitizing the health care professionals on the prevention of the potential transmission of MRSA through cell phones to hospitalised patients has to be stressed. Protocol must be formed to restrict the usage of cell phones in sensitive areas of the hospital. In addition, hand hygiene and sterilization of cell phones should be followed as it may prevent nosocomial infection and spread of MRSA into the community.

75% of the health care professionals and 5% of the community residents were aware of bacterial colonization on the cell phones. Hand hygiene measures were followed by 92% of health care professionals and 86% of community residents. Practice of disinfecting cell phones was lacking both in health care professionals and community residents. MRSA and MDR *Pseudomonas* were found in hospital a subject, which holds a threat of nosocomial infection. *Escherichia coli* and

Enterococci were found in the community resident, thereby showing their lack of following proper hand hygiene.

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