

Original Research Article

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Mobile Phones of Healthcare Workers – A Boon for Communication or A Potential Reservoir of Nosocomial Pathogens?

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A B S T R A C T

Hospital acquired infections are a problem in both developed and developing countries. India is ranked second in the list of number of mobile phone users in the world. Healthcare workers do use mobile phones. However they are seldom cleaned, therefore serve as potential reservoir of nosocomial pathogens: To determine the bacterial flora on mobile phones of HCWs and non HCWs; To determine the antimicrobial susceptibility pattern of microorganisms isolated from mobile phones of HCWs and non HCWs; To study the efficacy of decontamination with a single 70% isopropyl alcohol swipe. A total of 150 HCWs and 50 Non HCWs were involved in the study. The samples were collected aseptically from mobile phones before and after disinfection with 70% isopropyl alcohol using sterile cotton swab moistened with sterile normal saline. Pre- and post- disinfection swabs were inoculated onto blood agar and MacConkey agar plate, incubated aerobically at 37°C for 24 hours. Identification was done as per recommended standard microbiological methods. Antimicrobial susceptibility testing was performed as per CLSI guidelines. Among 150 mobile phones of HCWs, 141 yielded single or mixed growth with a total of 306 isolates. CONS (113) were prominent isolates followed by gram positive bacilli (96), MSSA (28), MRSA (24), *Pseudomonas* (14), *Micrococcus* (14), *Enterococcus* (10) and *E. coli* (7). Out of 50 Non HCWs, 15(30%) showed growth, of which 11 were CONS & 7 were Gram positive bacilli. Antimicrobial susceptibility testing showed multi drug resistant organisms in mobile phones of HCWs. The efficacy of decontamination was found to be 89% as only 15 mobile phones of HCWs showed growth after decontamination. We conclude that mobile phones of HCWs can act as a potential source of nosocomial infections and simple usage of alcohol disinfectant and hand washing practices can reduce the risk of infection.

Keywords

Mobile phones,
Nosocomial
infections, Health
Care Workers
(HCWs), 70%
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Introduction

In this electronic age, mobile phones are used as a means of communication which has made our life very simple and easy going. There are almost as many mobile phones as there are humans on the planet¹. India is ranked second

in the list of number of mobile phone users in the world². The greatest advantage of mobile phones compared to old telephones is that it can be used anywhere, anytime. It can be used as computer and the whole world in one's hand. It is easy to overlook its hazards to health when compared to its benefits.

Hospital acquired infections are a problem in both developed and developing countries³. The sources of infection can be endogenous or exogenous. Exogenous sources which can serve as reservoir of infection are patients, Health care workers (HCWs), inanimate objects like stethoscopes, mobile phones, and other items present in the immediate vicinity of the patient. Over a past decade, use of mobile phones has become indispensable in the hospital. It may support certain aspects of clinical diagnosis and education. Healthcare workers do use mobile phones. Microorganisms are transferred from patients to HCWs hand while attending the patients. If HCWs use mobile phones without proper hand washing, these microorganisms can be transferred to mobile phones.

If mobiles are not cleaned and again used while attending another patient, these organisms can be transferred to other patients and can cause nosocomial infections. If the transferred organisms are antibiotic resistant strains then mobile phones can act as a potential reservoir of nosocomial pathogens. Even sharing of mobile phones between HCWs and non HCWs may directly lead to transfer of resistant strains to community. Hence the present study was done to determine the organisms associated with the mobile phones of HCWs and its susceptibility pattern, to determine efficacy of decontamination with alcohol and also to develop awareness in HCWs and non HCWs for proper handling of mobile phones.

The main objectives of this study includes to determine the bacterial flora on mobile phones of HCWs and non HCWs. Also, to determine the antimicrobial susceptibility pattern of microorganisms isolated from mobile phones of HCWs and non HCWs. And to study the efficacy of decontamination with a single 70% isopropyl alcohol swipe.

Materials and Methods

This prospective cross sectional study was conducted at Khaja Banda Nawaz teaching and general hospital dated from 1st August to 31st August 2019. A total of 150 HCWs (doctors and nurses) and 50 Non HCWs (OPD patient attenders, members working in hospital canteen) were involved in the study. Participants using mobile accessories like Bluetooth devices, ear phones, etc were excluded from the study. Written informed consent was taken from the participants. The study was approved by the ethical committee of our institute.

The samples were collected aseptically from mobile phones (front, back and sides) before disinfection with alcohol using sterile cotton swab moistened with sterile normal saline. Disinfection of mobile phones was done using a single 70% isopropyl alcohol swipe. Mobile phones were allowed to dry for 10 minutes.

After 10 minutes samples were collected in the same said manner. Pre- and post-disinfection swabs were inoculated onto blood agar and MacConkey agar plate, incubated aerobically at 37°C for 24 hours. Identification was done as per recommended standard microbiological methods⁴. Methicillin resistance of isolated *S. aureus* was detected by cefoxitin disc diffusion method as per CLSI guidelines⁵. Antimicrobial susceptibility testing was performed on Mueller Hinton Agar using Kirby Bauer disk diffusion method as per CLSI guidelines⁵.

Results and Discussion

Among 150 mobile phones of HCWs before decontamination, 141(94.05%) yielded single or mixed growth with a total of 306 isolates. Among 50 mobile phones of Non HCWs before decontamination, 15(30%) yielded single or mixed growth with a total of 18

isolates (Table 1 and 2). Out of 141 positive microbial growth on mobile phones of HCWs, Coagulase negative Staphylococci (CONS) (113;80.14%) were predominant isolates followed by Gram positive bacilli (96;68.1%), Methicillin sensitive *Staphylococcus aureus* (MSSA) (28;19.8%), Methicillin resistant *Staphylococcus aureus* (MRSA) (24; 17%), *Pseudomonas* (14; 9.9%), Micrococcus (14; 9.9%), *Enterococcus* (10;7.1%) and *E. coli* (7; 4.9%). Out of 15 positive microbial growth on mobile phones of Non HCWs CONS (11; 73.34%) were predominant isolates followed by Gram positive bacilli (7; 46.67%) (Table 2).

In HCWs, 24 isolates were found in 15 mobile phones after decontamination, of which 11(73.34%) were found to be CONS, followed by Gram positive bacilli (7;46.67%), MSSA (4;26.67%), MRSA (2;13.34%) (Table 3).

In HCWs, all gram positive organisms were complete sensitive to LZ, VA and TEI except MRSA which is 79% sensitive to VA. CONS were least sensitive to AK & E (73%). Gram positive bacilli were least sensitive to GEN (68%). MSSA were least sensitive to GEN & E (50%). MRSA were least sensitive to E (21%). Micrococcus was least sensitive to CIP (64%). *Enterococcus* was least sensitive to CIP (40%) (Table 4). In HCWs, all gram negative organisms were sensitive to IMP, PI, TOB & CL. *Pseudomonas* was least sensitive to AK, GEN & CIP (36%). *E. coli* were least sensitive to GEN (29%) (Table 5). The mobile phones of Non HCWs showed growth of only gram positive organisms. CONS were 100% sensitive to AMC, CD, DO, LZ, VA& TEI and least sensitive to CIP & E. Gram positive bacilli is 100% sensitive to AMC, LZ, VA & TEI and least sensitive to CIP & E (71%) (Table 6). The efficacy of decontamination

with a single 70% isopropyl alcohol swipe was found to be 89% as only 15 mobile phones of HCWs showed growth after decontamination. There was no growth of microorganism observed in mobile phones of non HCWs after decontamination (Table 7).

The first mobile telecommunication was started in Europe in 1982 for improvement in communication system. In India, the first use of mobile phone was done in 1995. Today more people worldwide own mobile phones than have access to working toilets⁶.

Mobile phones are carried by the doctors and HCWs and are extensively used within the hospital premises including areas like Operation theatres and Intensive care units which may serve as reservoirs of potentially pathogenic bacteria leading to infections.

In a study it was discovered that average cell phone is dirtier than either a toilet seat or the bottom of your shoe⁷. Our phones are ideal breeding sites for microbes as they are kept warm and snug in our pockets and handbags.

Hence, the present study was undertaken to determine the bacterial flora on mobile phones of HCWs & their antimicrobial susceptibility pattern.

Out of 150 cell phones of HCWs, growth was observed in 141 (94.05%) cell phones. Our study findings are similar to the findings of other studies done by Neha Sharma *et al.*,⁸, Jayalakshmi *et al.*,⁹, Ulger *et al.*,¹⁰, and Sham *et al.*,¹¹ which showed positivity of 87%, 91.6%, 94.5% and 99% respectively and it is in contrast to other studies done by Usha *et al.*,¹², Ramesh *et al.*,¹³ and Kabir *et al.*,¹⁴ which showed positivity of 40.62%, 45% and 62% respectively (Fig. 1 and 2).

Table.1 Number of cell phones showing microbial growth before decontamination

	Total samples	Positive growth	Percentage
HCWs	150	141	94.05%
Non HCWs	50	15	30%

Table.2 Comparison of microbial growth on cell phones of HCWs and Non HCWs before decontamination

Organisms isolated	HCWs (T=141)		Non HCWs (T=15)	
	Number	Percentage	Number	Percentage
CONS	113	80.14%	11	73.34%
Gram positive bacilli	96	68.1%	7	46.67%
MSSA	28	19.8%	--	--
MRSA	24	17%	--	--
Micrococcus	14	9.9%	--	--
Pseudomonas	14	9.9%	--	--
Enterococcus	10	7.1%	--	--
E coli	7	4.9%	--	--

Table.3 Comparison of microbial growth on cell phones of HCWs and Non HCWs after decontamination

Organisms isolated	HCWs (T=15)		Non HCWs (T=0)	
	Number	Percentage	Number	Percentage
CONS	11	73.34%	0	0
Gram positive bacilli	7	46.67%	0	0
MSSA	4	26.67%	0	0
MRSA	2	13.34%	0	0

Table.4 Antibiotic sensitivity pattern of Gram positive organisms isolated from mobile phones of HCWs

Organisms	No. of isolates	CX	AK	GEN	AMC	CTX	CIP	E	CD	DO	LZ	VA	TEI
CONS	113	80%	73%	80%	85%	80%	85%	73%	75%	79%	100%	100%	100%
Gram positive bacilli	96	76%	75%	68%	75%	82%	84%	80%	81%	76%	100%	100%	100%
MSSA	28	100%	57%	50%	75%	71%	64%	50%	64%	71%	100%	100%	100%
MRSA	24	0%	34%	29%	37%	25%	46%	21%	50%	58%	100%	79%	100%
Micrococcus	14	79%	71%	86%	86%	79%	64%	86%	100%	79%	100%	100%	100%
Enterococcus	10	50%	70%	60%	60%	60%	40%	50%	100%	50%	100%	100%	100%

CX – Cefoxitin, AK – Amikacin, GEN – Gentamicin, AMC – Amoxicillin/Clavulanate, CTX – Cefotaxime, CIP – Ciprofloxacin, E – Erythromycin, CD – Clindamycin, DO – Doxycycline, LZ – Linezolid, VA – Vancomycin, TEI – Teicoplanin

Table.5 Antibiotic sensitivity pattern of Gram negative organisms isolated from mobile phones of HCWs

Organisms	No. of isolates	AK	GEN	AMC	CTX	CAZ	CXM	CIP	IMP	PI	TOB	CL
<i>Pseudomonas</i>	14	36%	36%	64%	71%	64%	71%	36%	100%	100%	100%	100%
<i>E coli</i>	07	43%	29%	71%	57%	57%	43%	43%	100%	100%	100%	100%

CAZ – Ceftazidime, CXM – Cefuroxime, IMP – Imipenem, PI – Piperacillin, TOB – Tobramycin, CL – Colistin

Table.6 Antibiotic sensitivity pattern of microorganisms isolated from mobile phones of Non HCWs

Organisms	No. of isolates	CX	AK	GEN	AMC	CTX	CIP	E	CD	DO	LZ	VA	TEI
CONS	11	91%	91%	91%	100%	91%	73%	73%	100%	100%	100%	100%	100%
Gram positive bacilli	07	86%	86%	86%	100%	86%	71%	71%	86%	86%	100%	100%	100%

Table.7 Efficacy of decontamination with a single 70% isopropyl alcohol swipe

	No. of cell phones of HCWs showing microbial growth	No. of cell phones of Non HCWs showing microbial growth
Before decontamination	141	15
After decontamination	15	0
Efficacy of 70% isopropyl alcohol	89%	100%

Fig.1 Comparison of microbial growth of mobile phones of HCWs & Non HCWs before decontamination

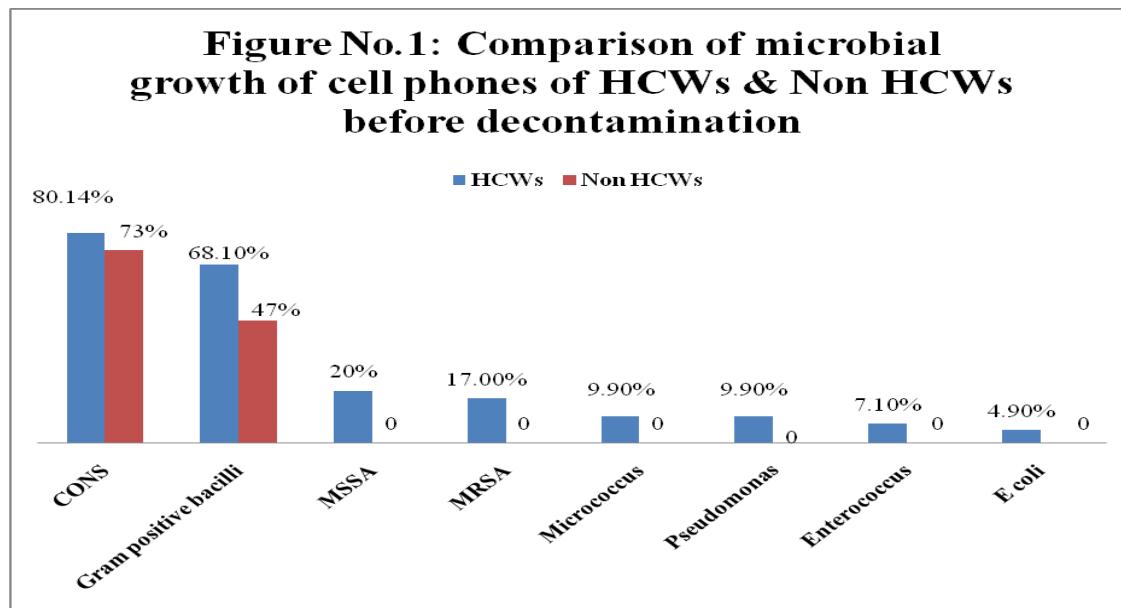
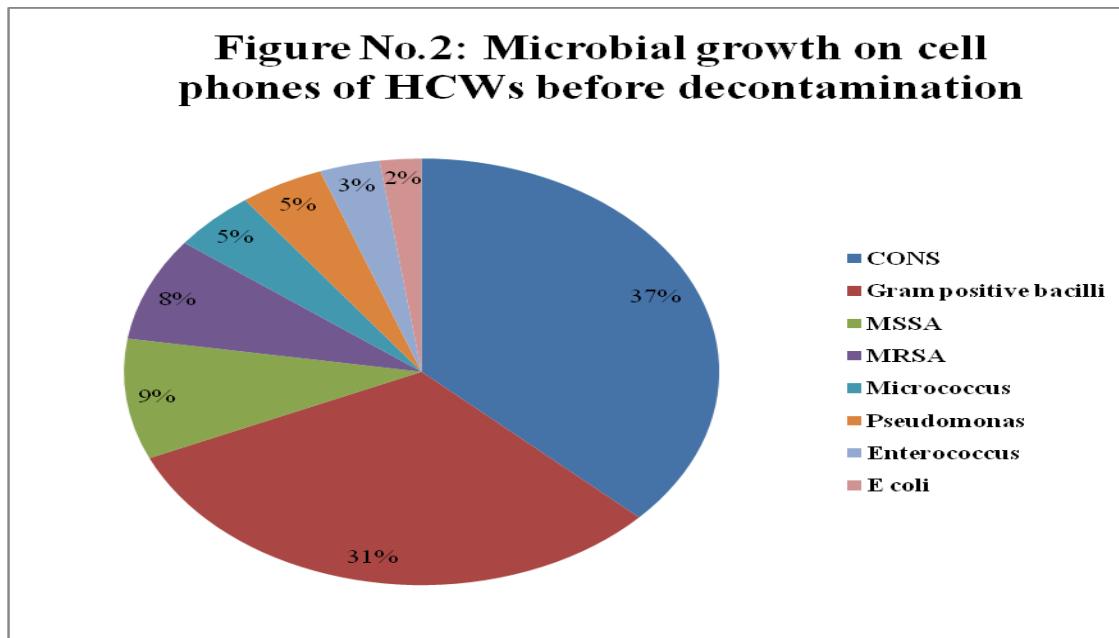


Fig.2 Microbial growth on cell phones of HCWs before decontamination



In HCWs, a total of 306 bacterial isolates were isolated of which Coagulase negative staphylococcus (113; 80.14%) was the most predominant organism, followed by Gram positive bacilli (96; 68.1%), Methicillin sensitive *Staphylococcus aureus* (28; 19.8%), Methicillin resistant *Staphylococcus aureus* (24; 17%), *Micrococcus* (14; 9.9%), *Pseudomonas* (14; 9.9%), *Enterococcus* (10; 7.1%) and *E. coli* (7; 4.9%).

In our study CONS was the most common organism in HCWs which goes well with the studies of Usha *et al.*,¹² Jayalakshmi *et al.*,⁹ Harish Trivedi *et al.*,¹⁵ and Kabir *et al.*,¹⁴. Although CONS is a normal skin flora responsible for a large number of hospital acquired infections but often proves difficult to treat because of the bacterium's genetic characteristics and growing resistance to high-powered antibiotics¹⁵.

In our study MRSA was isolated in cell phones of HCWs which correlates well with the results obtained by Jayalakshmi *et al.*,⁹ and Usha *et al.*,¹² who have shown that MRSA

was isolated only from the cell phones of HCWs. The presence of *E. coli* suggest fecal contamination of mobile phones which can result in community acquired infections and disease outbreaks.

However, out of 50 cell phones of non HCWs, growth was observed in only 15 (30%) cell phones, of which 11(73.34%) were CONS, 7(46.67%) gram positive bacilli and the remaining were sterile. In other studies done by Usha *et al.*,¹² and Datta *et al.*,¹⁶ in Non HCWs, growth was observed in 21.25% and 10% respectively.

Antibiotic susceptibility testing (AST) indicates marked resistance of bacterial isolated to commonly used antibiotics. This could be attributed to over the counter sale of antibiotics without any medical prescription leading to antibiotics abuse and high antibiotic resistance.

A simple procedure of decontaminations with a single 70% isopropyl alcohol swipe was done on both HCWs and non HCWs mobile

phones. The efficacy of decontamination was found to be 89% as only 15 cell phones showed growth consisting of CONS(11;73.34%), followed by Gram positive bacilli(7;46.67%), MSSA(4;26.67%), MRSA(2;13.34%) among HCWs & 100% among non HCWs. Similar results were shown by studies done by Neha Sharma *et al.*,⁸ and Usha A *et al.*,¹² who got efficacy of 80% and 98% respectively by using 70% isopropyl alcohol for mobile decontamination.

Organisms like *Staphylococcus aureus* and coagulase negative staphylococcus resist drying and thus can survive and multiply rapidly in the warm environments like cell phones. Furthermore, formation of one biofilm by one bacterial agent can affect the survival of other pathogens on the same surface¹⁷.

The higher rates of contamination of cell phones in HCWs in our study might be due to the influence of various factors like general hygiene and hand washing practices of the HCWs, disinfection practices, frequency of use and cleaning of cell phones etc. Also, there are no guidelines for the care, cleaning and restriction of mobile phones in our health care settings. Thus the mobile phones may serve as mechanical vectors for transmission of multi drug resistant organisms to patients and even to their family members. Hand washing is the simplest and most economical measure that can prevent transfer of harmful pathogens. Periodic decontamination of the mobile phones with alcohol disinfectant may reduce the risk of cross contamination caused by mobile phones. Other measures include staff education, restricting use of mobile phones in high risk areas in hospital like intensive care units, operation theatres, burn units etc.

We conclude that mobile phones of HCWs can act as potential source to spread nosocomial infections as they were highly

contaminated with various multidrug resistant bacteria. We also conclude that a single 70% isopropyl alcohol swipe can reduce the risk of contamination of mobile phones. Since restriction on the use of mobile phones by HCWs in hospital is not a practical solution, we recommend simple measures like hand washing after examining each patient, using hand free mobile phone during working hours, periodic cleaning of mobile phones with 70% isopropyl alcohol, a good hospital infection control programme and creating awareness in HCWs as well as non HCWs for proper handling of mobile phones to reduce rate of HAIs. Mobile phones are a boon for communication but it is up to us not to make it a bane.

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