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A study of presence of microbes on surface of touch screen of mobile phones in health care professionals

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Abstract
Background: Cell phones are increasingly becoming an important means of communication in India. Being expensive and conveniently small in size, they are used by doctors and other health care workers (HCWs) in a hospital for immediate communication during emergencies, in rounds, and even in operation theatres and intensive care units. 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 in recent years, When these HCWs do not wash their hands or do not practice standard infection control measures, they are responsible for transmission of nosocomial infections. Effective hand-washing to decrease the transient contaminant flora in the skin is recognised as a critical factor in infection control policies.
Materials and Methods: The present study was a Hospital based, observational, cross sectional study carried out from September 2018 to August 2019, in pt jnm medical college Raipur Chhattisgarh on 240 cases satisfying the inclusion criteria following complete assessment. Patients were assessed for Characteristics of HCW, prevalence of microorganisms, awareness of infection spread via mobile, hand hygiene
Result: Evaluation done on the basis of distribution and prevalence of gram positive bacteria, gram negative bacteria, Coagulase Negative Staphylococcus and other bacteria in mobile surface and in disinfectant
Conclusion: Microbial contamination of the mobile phones and their increased use among the HCWs pose a significant epidemiological risk to the public. Simple measures such as proper hand hygiene practice, regular decontamination of the mobile phones with alcohol wipes and limiting use of mobile phones with in the hospital premises including working area like operation theatres and intensive care units may reduce the risk of Hospital Acquired Infection caused by these devices.

Keywords: health care workers (HCWS), coagulase negative staphylococcus (CONS)

Introduction

Human skin is constantly covered with micro-organisms, both commensals and pathogens depending on topography, environmental factors and host factors [1]. Cell phones are increasingly becoming an important means of communication in India. Being expensive and conveniently small in size, they are used by doctors and other health care workers (HCWs) in a hospital for immediate communication during emergencies, in rounds, and even in operation theatres and intensive care units [2]. They may serve as mobile reservoirs of infection allowing the transportation of the contaminating bacteria to many different clinical environments [3]. Further, sharing of cell phones between HCWs and non HCWs may directly facilitate the spread of potentially pathogenic bacteria to the community. The potential of cell phones as vectors to nosocomial infection has been studied before [2-4]. These studies reported that the most commonly found bacterial isolate was Coagulase Negative Staphylococcus (CONS) as a part of normal skin flora. In recent years, *Staphylococcus epidermidis* is regarded as an agent of hospital and community acquired infections. They act as causative agent of bloodstream infections, urinary tract infections and surgical site infections and increasing incidence of drug resistance in these organisms. Penicillin resistant *Staphylococcus* are seen in individuals working in hospitals. The skin of health care providers harbors commensals as well as pathogens including drug resistant organisms due to exposure to hospital environment. [4, 5, 6] When these organisms are present on the skin of HCWs they act as source of nosocomial infection. [7, 8] When these HCWs do not wash their hands or do not practice standard infection control measures, they are responsible for transmission of nosocomial infections. Effective hand-washing to decrease the transient contaminant flora in the skin is recognized as a critical factor in infection control policies [9]. Use of personal protective equipment (gloves, mask, apron, cap and goggles) also plays an important role in protecting the HCWs as well as in reducing the transmission of microorganisms by the HCWs. Adherence to hand hygiene practices is considered as an integral part of quality health care [10]. Bacterial flora on cell phones of HCWs may vary in composition, number and antibiotic sensitivity, to that found on cell phones of non-HCWs. Hence, the present study was carried out with the objective to study the presence of microbes on surface of touch screen of mobile phones in health care professionals.

Materials and Method

The present study was a Hospital based, observational, cross sectional study carried out from September 2018 to August 2019, in ptjnm medical college Raipur Chhattisgarh on 240

cases satisfying the inclusion criteria following complete assessment. Patients were assessed for Characteristics of HCW, prevalence of microorganisms, and awareness of infection spread via mobile, hand hygiene

Inclusion criteria

a. Those who have smart cell phone of touch screen type.
b. Those who use same cell phone for >3 months of duration

Exclusion Criteria

a. Those who use Keypad type cell phone.
b. Those who use same cell phone < 3 months of duration

Methodology

A moistened sterile cotton- swab stick will be used aseptically to collect sample by rolling the swab from the surface of touch screen of mobile phones of health care professionals. After obtaining consent, collected swab sample will be immediately sent to microbiology laboratory in nutrient broth.Further, for culturing they will be inoculated on Blood agar, Nutrient agar and Mac Conkey agar. The cultured plate will be then incubated aerobically at 37.C for 18 to 24 hours and will be observed for any visible growth. Micro-organism will be identified by gram staining, colony morphology and by standard biochemical tests. Data was collected by using a structure Performa. Data thus was analyzed by using SPSS 24.0 version IBM USA. Qualitative data was expressed in terms of percentages and proportions. Quantitative data was expressed in terms of Mean and Standard deviation. Association between two qualitative variables was seen by using Chi square/ Fischer's exact test. Comparison of mean and SD between two groups will be done by using

Results and Observation

Out of 240 mobile phones, growth quantification was seen in 108 cases out of which skin commensals were present in majority of cases i.e. 40(16.7%) followed by CoNS in 35 cases (14.6%), GPB in 16(6.7%), contaminated growth in 11(4.6%), GPC in 4(1.7%) and GNB in 2 cases i.e. 0.8%.

Table 1: Distribution according to type of microorganism isolated

		Present		Absent	
		Frequency	Percent	Frequency	Percent
Microorganisms	GPC	4	1.7	236	98.3
	GPB	16	6.7	224	93.3
	GNB	2	0.8	238	99.2
	CoNS	35	14.6	205	85.4
	Skin commensals	40	16.7	200	83.3
	Contaminated Growth	11	4.6	229	95.4

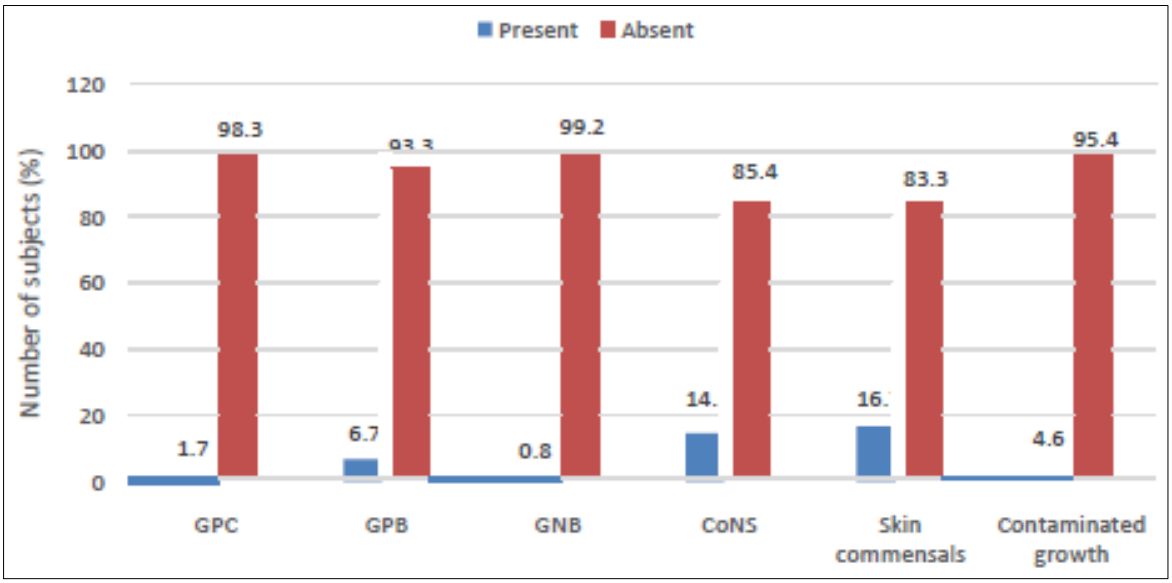

Fig 1: Distribution according to type of microorganism isolated

Our all study participants use touch screen phones. Majority of them i.e. 214 (89.2%) were using it since more than one year Our all study participants were aware about spread of infection through mobile phones Majority of the HCWs i.e. 239 (99.6%) do not wash hands before using mobile but they use disinfectant to wipe their mobile phones. Majority of the HCWs i.e. 215 (89.6%) use Sterilium for disinfection of mobile phones followed by 16(6.7%) using spirit, 8(3.3%) using NS swabs and 1(0.4%) using water swab. Majority of the HCWs i.e. 209 (87.1%) practice disinfection of their mobile phones two to five times per day followed by 20(8.3%) practicing it for only once per day and only 11(4.6%) practicing it for more than five times per day. Majority of the HCWs i.e. 228 (95%) practicing disinfection of their mobile phones for less than one minutes and only 12(5%) practicing it for more than one minutes

Table 2: Distribution according to awareness about spreading of infection

		Frequency	Percent
Do you use touch screen Phone	Yes	240	100.0
Since how long using	Less than one year	26	10.8
	More than one year	214	89.2
Are you aware about spread of infection through mobile phones	Yes	240	100.0
Do you wash handsbefore using mobile	No	239	99.6
Do you use disinfectant to wipe your mobile phones	Yes	239	99.6
	No	1	0.4
	Total	240	100.0
Type of disinfectant used to wipemobile	Spirit	16	6.7
	Sterilium	215	89.6
	Water swab	1	0.4
	NS swab	8	3.3
Frequency of use of disinfectant to wipe mobile (Per day)	Once	20	8.3
	Two to five times	209	87.1
	More than five times	11	4.6
For how long wiping Followed	< 1 minutes	228	95.0
	> 1 minutes	12	5.0

Swabs report according to category of health care workers revealed that mobile phones of 35 doctors (58.3%) found to be positive out of 60 followed by 33 PG students out of 60 (55.1%), 22 Lab technicians out of 60 (36.7%) and 18 nurses out of 60 (30%).Presence of skin commensals were dominant in all category of HCWs.

Table 3: Distribution according to type of microorganism isolated with respect to HCW

	Doctors		Nurses		Lab technician		PG students	
	NU	%	NU	%	NU	%	NU	%
GPC	1	1.7	2	3.3	1	1.7	0	0
GPB	9	15	3	5.0	3	5	1	1.7
GNB	0	0	1	1.7	0	0	1	1.7
CoNS	8	13.3	6	10.0	5	8.3	16	26.7
Skin commensals	11	18.3	6	10.0	12	20	11	18.3
Contaminated growth	6	10	0	0.0	1	1.7	4	6.7
Total	35	58.3	18	30.0	22	36.7	33	55.1

We included total 240 health care workers including consultants, lab technicians, nursing staff and post graduate students in our study (60 each i.e. 25%)

Table 4: Distribution according to type of health care workers

		Frequency	Percent
Categorisation of HCW	Consultant	60	25.0
	LT(Lab Technician)	60	25.0
	Nurse	60	25.0
	PG Student	60	25.0
	Total	240	100.0

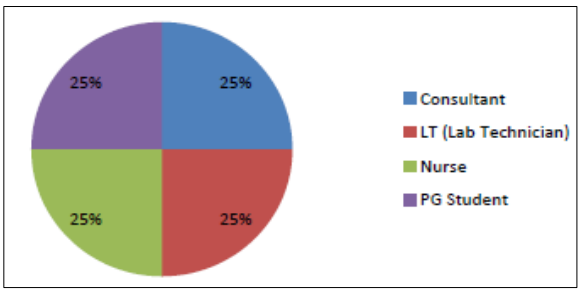

Fig 2: Distribution according to type of health care workers
Growth quantification of mobile phones was seen in 108 cases i.e. 45%

Table 5: Distribution according to growth quantification

		Frequency	Percent
Growth quantification	Present	108	45.0
	Absent	132	55.0
	Total	240	100.0

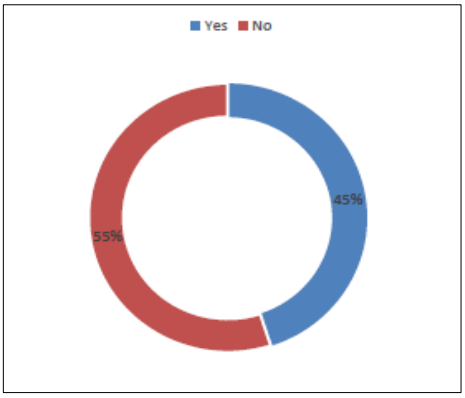

Fig 3: Distribution according to growth quantification

Discussion

We included total 240 health care workers including consultants, lab technicians, nursing staff and post graduate students in our study (60 each i.e. 25%). Majority of health care workers were from pathology department i.e. 50(20.8%), 48 (20%) Medicine, 34 (14.2%) nephrology, 30(12.5%) surgery and 12 i.e. 5% each from orthopaedics and SICU department respectively. Anupriya A. *et al* [11] in 2018 conducted cross-sectional prospective study conducted in a tertiary care hospital among 110 swab samples collected from the mobile phones of health care workers versus non-health careworkers. Sureshkumar M. *et al* [12] in 2018 conducted prospective study with the objective to know the microbial flora on skin of Health Care Workers (HCWs) and to create awareness on the effective infection control measures at Vinayaka Mission's Kirupananda Variyar Medical College, Salem for a period of four months. Two swabs were collected from 130 Health Care Workers (HCWs) (Doctors, Staff nurse, Medical students, Lab technicians and Housekeeping staff) and subjected to bacterial and fungal culture. Canales MB *et al* [13] in 2017 conducted study with a total of 175 samples were examined, out of which 125 samples were from healthcare workers (HCWs), 50 samples were from non-

healthcare workers (non-HCWs). Isolation of microorganisms and the growth pattern In our study, out of 240 mobile phones, growth quantification was seen in 108 cases out of which skin commensals were present in majority of cases i.e. 40(16.7%) followed by CoNS in 35 cases (14.6%), GPB in 16(6.7%), contaminated growth in 11(4.6%), GPC in 4(1.7%) and GNB in 2 cases i.e. 0.8%. In our study, swabs report according to category of health care workers revealed that mobile phones of 35 doctors (58.3%) found to be positive out of 60 followed by 33 PGs out of 60 (55.1%), 22 Lab technicians out of 60 (36.7%) and 18 nurses out of 60 (30%) Presence of skin commensals were dominant in all category of HCWs in our study. Mobile phones of doctors showed 11(18.3%) skin commensals and 9(15%) showed GPB. Mobile phones of PGs showed 11(18.3%) skin commensals and 16(26.7%) showed CoNS. Mobile phones of LTs showed 12(20.0%) skin commensals and 5(8.3%) showed CoNS. Mobile phones of nurses showed 6(10%) skin commensals and 6(10%) showed CoNS. Majority of the HCWs i.e. 215(89.6%) use Sterillium for disinfection of mobile phones followed by 16(6.7%) using spirit, 8(3.3%) using NS swabs and 1(0.4%) using water swab. In our study out of 240samples, 228 HCWswiped their mobile phones for <1minute and among them 108 (47.36%) mobile phones showing presence of Out of 240 mobile phones, GPC were present on 4 mobile phone, out of which 3 cases were found on sterillium disinfected phone and 1 case was found on Normal Saline swab disinfected phone. Out of 240 mobile phones, GPB were present on 16 mobile phone, out of which 15 cases growth. And only 12 HCWs wiped their mobile phones for >1 minute and this group was not showing any growth on mobile phones. In our study out of 240 sample, 239 HCWs disinfect their mobile phone and out of them 108 mobile phone showing presence of growth, and 1HCW do not disinfect his mobile phone and no growth was found on mobile phone. Out of 240 mobile phones, contaminated growth were present on 11 mobile phone, and all 11 cases were found on sterillium disinfected phone. Sureshkumar M. *et al* [12] in 2018 reported that bacterial growth was observed in all the HCWs (100%) and fungus was isolated from eight HCWs (6.2%). Among the bacterial isolates, Diphtheroids (47) were the predominant isolate accounting for 29% followed by coagulase negative *Staphylococcus* (39) which was 24% of isolates. The predominant pathogen isolated was *Staphylococcus aureus* (15%, 25 isolates). 17% (11 isolates) of Staphylococci were resistant to Cefoxitin which indicates both MRSA and MR-CONS. Among gram-negative isolates, most of them were resistant to ampicillin, cotrimoxazole and cephalosporins. *Candida* (4 out of 8, 50%) was the predominant fungal isolate. Anupriya A. *et al* [11] in 2018 in their study reported that two and more than two types of growth were predominant among both health care workers (56.4%) versus non-health care workers (29.1%). Coagulase negative *Staphylococcus* was predominant followed by aerobic spore bearers and micrococci in the study group. Canales MB etal [13] in 2017 found that among the mobile phones of HCWs from ICUs, *Acinetobacter baumannii* (36.84%) was the predominant organism isolated followed by methicillin resistant *Staphylococcus aureus* (MRSA) were found on sterillium disinfected phone and 1 case was found on Normal Saline swab disinfectedphone. Out of 240 mobile phones, GNB were present on 2 mobile phone, and both of the cases were found on sterillium disinfected phone Out of 240 mobile phones, CoNS were present on 35 mobile phone, and all 35 cases were found on sterillium disinfected phone. Out of 240 mobile phones , skin commensal were present on 40 mobile phone out of which 37 cases were found on sterillium disinfected phone and 1 case was found on spirit disinfected phone and 2 case was found on Normal Saline swab disinfected phone. (21.05%). Predominant organism isolated from HCWs in operation theatre was MRSA (46.66%). Out of 50 workers' non-HCWs mobile phones samples cultured, 23 (46.00%) samples yielded growth of six different types of bacteria. Our findings are almost comparable with the findings of above-mentioned authors. Rate of contamination of mobile phones of HCWs in present study coincides with studies performed by Marwa*et al* [14] Rate of contamination of mobile phones of non-HCWs reported by Misgana *et al* [15] was consistent with the present study. Bacteria known to cause HAIs have varied by clinical settings and have included MRSA, *A. baumannii*, and *Pseudomonas*s pecies. Staphylococcal species especially *S. epidermidis* normally found on skin flora, this might be the reason for their high rate of growth from the mobile phones in the present study. *S. aureus* can cause various illnesses, from minor skin infections to much more serious diseases, which include pneumonia, bacteraemia, septicaemia etc. MRSA is of particular importance in the medical community, as it has evolved resistance to β-lactam antibiotics. Several studies also revealed that HCWs donot consider mobile phones to be contaminated items and rarely disinfect their phones. Hand washing is the most effective method for the prevention of bacterial transmission. Although there are strict rules on hand hygiene in hospitals, it is not possible to provide decontamination, disinfection or sterilization of each device used personally. Even though the presence of some items can be restricted in the hospital setting, it is not possible to limit the use of mobile phones by HCWs due to their indispensable benefits. The Centers for Disease Control and Prevention (CDC)'s guidelines for environmental infection control in healthcare facilities recommend periodic disinfection after cleaning instruments and surfaces that often come into contact with the hands, such as computer keyboards and mouse, as defined by the infection control committee. Since the data collection of our study coincided with the covid 19 pandemic, majority of the HCWs were started practicing the standard hygiene precautions and were regularly disinfecting their mobiles. Hence in our study, very few numbers of microbes were isolated and thus the results found to be non-significant.

Conclusion

Microbial contamination of the mobile phones and their increased use among the HCWs pose a significant epidemiological risk to the public. Simple measures such as proper hand hygiene practice, regular decontamination of the mobile phones with alcohol wipes and limiting use of mobile phones with in the hospital premises including working area like operation theatres and intensive care units may reduce the risk of HAI's caused by these devices. Hence, we conclude that there is an urgent need to stress awareness among the HCWs about the potential role of mobile phones in transmission of infectious agents in and outside the hospital. Although regular cleaning of the mobile phones and adhering to the infection control practices would significantly decrease the transmission rate still there use inside the hospital premises should be restricted. Infection control committee of every hospital can step forward to make clear

cut guidelines regarding the use of mobile phones in health care set up and to create awareness among the health care workers in regard to proper practice of hand hygiene.

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Conflicts of interest
There are no conflicts of interest

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