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Original Research Article

Prevalence and antibiotic pattern of microbes isolated from mobile phones of health care workers and non- health care workers

Neha Sharma[1], Aruna Solanki[2], R.S.Parihar[2], P.K.Khatri[2], Arvind Chandora[2] and Archana Bora[2]

[1]Department of Biotechnology, Lachoo Memorial College of Science and Technology, Jodhpur
[2]Department of Microbiology, Dr. S.N. Medical College, Jodhpur, Rajasthan, India
Corresponding author

A B S T R A C T

Use of mobile phones by healthcare workers (HCWs) in the Operation theatre (OT), Intensive care unit (ICU) and Critical care unit (CCU) may have serious hygiene consequences as these patients are more vulnerable to hospital acquired infection.This study will assess possibility of spreading hospital acquired infection due to usage of mobile phones by HCW's working in OT,ICU,CCU and laboratory also,their causative microorganism and antibiotic sensitivity pattern compared with Non HCW's. After institutional ethics committee approval,this observational study was carried out in the government Mahtma Ghandi Hospital,Jodhpur (Rajasthan)INDIA. After written informed consent ,three groups (doctors, nurses and other health care personnel), total 50 samples were collected form the mobile phones and 50 samples were collected from the Non HCW's as a control .The samples were tested for the identification of microorganisms and antibiotic sensitivity. The prevalence of microbes was found to be *Klebseilla sp.* (60%) and least organism was *Candida albicans* (8%) in HCW's and but in Non HCW's prevalent organism was *Staphylococcus aureus* (52%), and least organism was *Candida albicans* (6%). The sensitivity rates to commonly used antimicrobials in isolated bacteria from phones varied from 36.25% for Ampicillin to 82.5% for Piperacilin in HCW's and in Non HCW's, it is varied from 49.15% for Oxacillin to 63.93% for Gentamicin and Tobramycin. As a result of this study, all tested samples were found to be contaminated with mixed growth. Gram positive and gram negative pathogenic and non pathogenic bacteria were isolated. These results suggested that close contact objects that were contaminated could serve as reservoirs of microbes. Here in mobile phones are particularly problematic when compared to immobile devices and it may facilitate transmission of microbial isolates from patient to patient in wards or hospitals. Developing active preventive strategies like decontamination of mobile phones with alcohol containing disinfectant might reduce cross-infection. Another way of reducing microbial contamination on mobile phones is by enlightening the public on the microbial colonization of mobile phones and the use of regular cleansing agents and rearranging of their environment. This was the first study which was carried in Jodhpur, city of largest Indian state of Rajasthan.

K e y w o r d s

Mobile Phones; Health Care Workers; Non Health Care Workers; Hospital Acquired Infections; Bacteria.

Introduction

Nosocomial infections continue to pose risks of increased mortality and morbidity in patients. Inanimate objects in the hospital environment are known to be

contaminated with microorganisms. 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 worker in hospital for immediate communication during emergencies, in rounds and even in operation theaters and intensive care units. They may serve as mobile reservoirs of infection allowing the transportation of the contaminating bacteria to many different clinical environments. Further, sharing of cell phones between HCW's and Non HCW's may directly facilitate the spread of potentially pathogenic bacteria to the community (Chawala *et al*., 2009).

Mobile phones have become an extension of office practice for physicians, and may serve as perfect substrate for microorganisms, especially in high temperature and humid conditions. Extensive use of mobile phones by HCW's acts as a vehicle for transmission of nosocomial agents. Over the past decade, mobile phones (MPs) have become an essential accessory in our social and professional life. The mobile phones of HCW's harbor many harmful pathogens which serve as a reservoir for nosocomial infections (Brady *et al*., 2007). Because of the achievements and benefits of the mobile phone, it is easy to overlook its hazard to health; this is against the background that many users may have no regard for personal hygiene, and the number of people who may use the same phone. This constant handling of the phone by different users exposes it to an array of microorganisms, and makes it a good carrier for microbes, especially those associated with the skin resulting in the spread of different microorganisms from user to user (Ekrakene et. al., 2007).

The combination of constant handling with the heat generated by the phones creates a prime breeding ground for many microorganisms that are normally found on the skin. Various pathogenic microbes associated with tuberculosis, meningitis, pneumonia, tonsillitis, peptic ulcers, genital tract infections, skin infections had been identified in mobile phones.

The use of mobile phones by HCW's in intensive care unit, burn wards and operative rooms may have more serious hygiene consequences, because unlike fixed phones, mobile phones are often used in the operating room close to the patients. Intensive care unit patients and burned patients are more vulnerable to infectious diseases, so the risk of transmission of organisms associated with nosocomial infections will be increased in these patients.

If the same phones are used both outside and inside of hospitals, our results indicate that, these contaminated phones can play a potential role in the spread of hospital infection microbes in the community. HCW's should be aware that their cellular telephones may carry potentially pathogenic microbes that may affect not only patients, but also their loved ones at home.

Hence, the present study is undertaken to screen the mobile phones of Health Care Workers and Non Health Care Workers and to create antibiotic sensitivity pattern of microbes isolated so that we can have better idea about the pathogenicity of microbes isolated. If microbes are multi drug resistant then their pathogenicity is more and if they are multi drug sensitive then their pathogenicity is less.

Since the restriction of mobile phones use by HCW's is not practically an effective method for prevention of nosocomial infections spread, the development of effective preventive strategies for well practiced infection control plan is an essential need to encompass environmental decontamination, hand hygiene, surveillance, and contact isolation for prevention of such nosocomial infections. Simple cleaning of computers and telephones with 70% isopropyl alcohol may decrease the bacterial load.

Our study has certain limitations that surface sampling of the environment and cultures from the hands of the personnel were not done.

Materials and Methods

The present study was conducted at Microbiology Laboratory in Mahatma Gandhi Hospital attached to Dr. S.N. Medical College (Jodhpur) Western Rajasthan, INDIA to find out incidence, prevalence and antibiotic sensitivity pattern of microbes isolated from mobile phones.

Sample Collection

Sample collection was done randomly from each mobile one sample was collected. A sterile cotton swab moistened with sterile thioglycolate broth was rotated on the sides and over the keypad of mobile phones which were used for at least one month.

This was followed by decontamination of cell phones with 70% isopropyl alcohol. After allowing it to dry for 10 minutes, repeat swabs were taken from the cell phones.

Care was taken to make sure that the keypad and all the buttons were swabbed since these areas are most frequently in contact with the tips of fingers. 100 samples were screened, in which 50 samples were collected from HCW's and 50 from Non HCWs.

Culture Conditions

All the samples were inoculated on solid medium such as Blood and Mac Conkey agar and HiCrome agar medium and also in broth medium (Thioglycollate). Inoculated plates were incubated at 37°C in ambient air for 16-18 hours (to up 24 hours).

Identification of Organisms

After overnight incubation, the culture plates were examined for growth. Identification was performed both microscopically and macroscopically by using the standard microbiological and biochemical test (Mackie Mc Cartney Book). Preliminary identification of Microbes was based on colony characterization of organisms that is haemolysis in blood agar, changes in physical appearance in differential media and enzyme activities of organism (Elmer *et al*., 1997).

Grams Staining Technique

After bacterial identification, smears were prepared from colonies grown on culture plates. Smears were air-dried, heat fixed and stained by Gram's technique. This technique helps to group the bacterial pathogens into Gram positive or Gram negative by the ability of bacterial cells to retain primary stain. Culture (sabouraud's dextrose agar with chloramphenicol), germ tube test and morphological

identification on glucose agar test, sugar fermentation test, sugar assimilation test.

Antibiotic Sensitivity Test

Antibiotic sensitivity test method used was Kirby Bauer method (Bauer *et al*., 1966). The medium used in this is Muller Hinton agar. It is type of disc diffusion method.

Results and Discussion

In this study 50 mobile phone samples from test group (Health Care Workers) and 50 mobile phone samples from control group (Non Health Care Workers and community) were cultured. Most of the samples were collected from the doctors' mobile phones and least samples were collected from the technicians.(Table 1).Samples were collected from both Lachoo Memorial College of Science and Technology and normal community. Collection of samples was maximum from Lachoo Memorial College.(Table2). It observes that cell phones from HCW's shows higher carriage rate (94%) in comparison to those from Non HCW's (80%). (Table.3). Before decontamination 87% of mobile phones shows positive growth and 13% shows negative growth. But after decontamination with 70 % isopropyl alcohol only 20% cell phones shows growth and 80% shows negative growth. Thus proving the efficacy of decontamination. (Table 4). It observes in this study that 30% of phones grew one bacterial species, 40% two different species, 24% three or more different species and no bacterial growth were identified in 6% of phones of Health Care Workers and in case of Non Health Care Workers, It was found that 42% of phones grew one bacterial species, 36% two different species, 8% three or more different species and no bacterial growth were identified in 20% of phones. In over all we can say that HCW's, most of the sample shows growth of 2 type of organism. But in case of Non HCW's 1 type of organisms isolates in most of the samples (Table.5).

Comparison of Microbial Growth on Cell Phones of HCW's and Non HCW's shows that the isolated bacteria from Health Care Workers mobile phones and Non Health Care Workers mobile phones are similar. The finding of this research indicates that *Klebseilla sp., Streptococcus species, Staphylococcus albus, Staphylococcus aureus, Enterococcus sp., Pseudomonas sp., E.coli., Candida albicans* and Gram Positive Bacilli isolated are known to cause infections in humans.The rate of contamination was found to be that *Klebseilla sp. 60 %, Staphylococcus albus 50%, Staphylococcus aureus 38%, Pseudomonas sp. 4%, E.coli 2%, Enterococcus sp. 6%, Candida albicans* 8% and Gram Positive Bacilli 14% in Health Care Worker mobile phone and the rate of contamination was found to be that *Klebseilla sp.* 34%, *Staphylococcus albus* 32%, *Staphylococcus aureus 52%, Enterococcus sp.* 2%,*E.coli* 2%, *Candida albicans* 6% and gram positive bacilli 10% isolated in Non Health Care Worker.

Most of the organisms are similar, some of which isolates are known to cause human infections most especially among the immuno-compromised. Some of them are known to cause nosocomial infections. *Klebseilla* sp. is most prevalent organism isolates from Health Care Workers and least find organism is *Candida albicans* but *Staphylococcus aureus* is most prevalent organism isolates in Non Health Care Workers and least find organism is *Candida albicans* (Table.6).

Distribution of Bacterial Agents Isolated from HCW's shows that the contamination frequency varies from laboratories to different department of the hospital. The most of the contamination find in Lab Technicians 37.36%. In CCU and ICU *Staphylococcus albus* is most prevalent organism, in Burn Unit *Staphyloccus albus* and *Stapyloccus aureus* are equally find. But in Male Ward *Klebseilla* sp. is high in number, in Female Ward *Klebseilla* sp. and *Staphyloccus albus* are equal in number, in Emergency *Klebseilla sp.* is most frequently find organism. In laboratories, *Klebseilla* sp. is most prevalent organism in both Microbiology Lab and Central Lab but in case of Blood Bank *Staphyloccus albus* is prevalent organism. Our study included technicians of three department of Mahatma Gandhi Hospital. This group of volunteers is in direct contact with the time of collection and processing in the laboratory and usually this group of volunteers keeps their mobile phones on work bench. These might be the reason for getting more number of isolates. (Table 7).VThe most of the organisms isolates from Microbiology lab (18.68 %), followed by Burn Unit (15.39%),Male Ward (10.98%) and CCU ,Emergency and Blood Bank (9.89%) ,followed by Central lab (8.79%) and least contamination find in Female ward and ICU (7.69%) (Table 8).

As a result of this study, all tested samples were found to be contaminated with mixed growth. Gram positive and gram negative pathogenic and non pathogenic bacteria were isolated. More pathogen/opportunist bacteria were isolated from mobile phones of Health Care Staffs than the ones of control group.

Antibiotic Susceptibility Testing

Total 91 bacterial isolates from the mobile phones belonging to six different species and out of 91, only 80 isolates were subjected to antibiotic susceptibility test according to Kirby- Bauer method and checked for antibiotic sensitivity to commonly available organisms.

The disc diffusion technique was employed and inhibition observed as clear zone around the antibiotics. Inhibition zones were measured using meter rule. The *Bacillus* sp. was not subjected to antibiotic susceptibility test as they are believed to be the normal flora.

There was a lot of variations in the sensitivity pattern obtained from different isolates from both the patterns against commonly used antibiotics (AN, CF, PIT, CD, OX, CFP, G, TOB, TCC, AZ, AMP and VA) in relation to pathogenic bacteria isolates from both group.

In HCW's¸ *Staphylococcus albus* shows maximum sensitivity to VA, PIT 96% and least sensitive to CF, TCC 68%. But in Non HCW's it shows complete sensitivity to most of the antibiotics.(Table 9).In HCW's it shows the maximum percentage of sensitivity to VA (89.47%) and least sensitive for AMP 15.78%. In Non HCW's it shows complete sensitive to AN, CFP, G, TOB, VA and least sensitive for OX 75%.(Table 10). In HCW's it shows very less sensitivity for antibiotics and in HCW's it find complete sensitive to most of the antibiotics. (Table 11).In HCW's, *Klebseilla* sp. finds to be more sensitive to AZ 93.33% and least sensitive to AMP 13.33% but in Non HCW's it finds complete sensitive to G and least sensitive to CF 58.33%.(Table 12). *E.coli.* finds to be sensitive to all antibiotics except one for CFP in HCW's and one for OX in Non HCW's.(Table 13). In HCW's *Pseudomonas* finds to be complete sensitive to AN, AZ, PIT, TOB and no one

isolates from Non HCW's.(Table 14). Over All Sensitivity of Microbes shows that the most sensitive drug finds in HCW's is PIT (82.5%). While in Non HCW's, it is G (63.93%) and TOB (63.93%). But the most resistant drug finds in HCW's was AMP (63.75%). While in Non HCW's it is OX (50.82%).The present study demonstrates that resistant rates to commonly used antimicrobials in isolates bacteria from phones varies from 17.50% for PIT to 63.75% for AMP in HCW's and in Non HCW's, it is varies from 36.03% for G and TOB to 50.85% for OX .

From the antibiotic sensitivity testing, it was observed that most of the isolates obtained from cell phones of both Health Care Workers and Non Health Care Workers were showing growth of multi drug sensitive organisms.(Table 15).

Microbes isolated from mobile phones reported to be leading cause of nosocomial and hospital acquired infections. Resistance of most of the microbes to commonly used antimicrobial agents is becoming an increasing clinical problem and a recognized public health threat because there are limited number of antimicrobial agents including Penicillin, Cephalosporin, Aminoglycoside and Fluoroquinolones with reliable activity against it.

This study "Prevalence and Antibiotic Sensitivity Pattern of Microbes Isolated from Mobile Phones of HCW's and Non HCW's was therefore carried out, using Kirby Bauer method, to determine the antibiotic sensitivity pattern of microbes from HCW's and Non HCW's (control group from Lachoo Memorial College of Science and Technology and from Community) at Mahatma Gandhi Hospital, Jodhpur (Rahasthan) INDIA, between 6 June 2011 to 8 September 2011.

According to our study, the rate of contamination is 94% in HCW's and 80% in non HCW's which is similar to the study conducted by Ulger *et al*. (2009) where the contamination rate was 94.5% in HCW's but they didn't consider the Non HCW's in their own study. But in contrast to this, the contamination rate was found to be lower (84%) in the study of Chandra *et al*. (2011) but the contamination rate was found to be higher (98%) in the study of Singh et. al. (2010) and a another study revealed that cell phones from the health care personnels working in clinical departments showed higher carriage rate (44.78%) as compared to those from non clinical side (37.77%) (Arora *et al.,* 2009). (Table -3)

In our study, pathogens on cell phones of HCW's and Non HCW's were compared. This study indicates that the carriage of *Klebseilla* sp. on the cell phones of HCW's is significantly higher than that of non HCW's. *Klebseilla* sp. is found to be 30 (60%), followed by *S.albus* 25 (50%),out of 50 in HCW's but in case of Non HCW's. S.*aureus* was found to be most prevalent organism 19 (38%) followed by *Klebseilla* sp. 17 (34%), out of 50.

However, in a study of Arora *et al. (*2009) showed that most prevalent organism was CONS, followed by *Staphylococcus aureus* in both clinical and non clinical samples. When our study was compared with the study of Tambekar *et al*. (2008), it revealed that *Staphylococcus aureus* was most prominent in HCW's and *Klebseilla* sp. was found to less in number. During the present set of laboratory experimentation other bacteria were also isolated– *P.aeruginosa, E.coli., Enterococcus* sp. . *P.aeruginosa* was found (4%) in a study conducted by

Table.1 Sample Distribution According to Hospital Department and Health Care Staff

DEPARTMENT	DOCTORS	NURSES	TECHNICIAS	TOTAL	F(%)
CCU *	4	4	-	8	16
ICU **	3	4	-	7	14
Burn unit	2	3	-	5	10
Male ward	2	3	-	5	10
Female ward	2	3	-	5	10
Emergency	4	2	-	6	12
Microbiology lab	2	-	3	5	10
Blood bank	2	-	4	6	12
Central lab	1	-	2	3	6
TOTAL	22	19	9	50	100

* CCU – Cardiac Care Unit; ** ICU – Intensive Care Unit

Table.2 Sample Collection Area for Non Health Care Workers (as a Control Group)

SAMPLE COLLECTION AREA	TOTAL NO. OF SAMPLES ANALYZED	
	NO. (n)	FREQUENCY (%)
Lachoo Memorial College	30	60
Community	20	40
TOTAL	50	100

Table.3 Number of Cell Phones Showing Growth

DEPARTMENT	GROWTH OBTAINED	F(%)	NO GROWTH	F(%)	TOTAL
HCW's *	47	94	3	6	50
Non HCW's **	40	80	10	20	50
TOTAL	87	87	13	13	100

* HCW's – Health Care Workers; ** Non HCW's – Non Health Care Workers

Table.4 Showing Result after Decontamination of Cell Phones with 70% Isopropyl Alcohol

CELL PHONES	GROWTH POSITIVE		GROWTH NEGATIVE		TOTAL
	No.	%	No.	%	
Before decontamination	87	87	13	13	100
After decontamination	20	20	80	80	100

Table.5 Number of Cell Phones that Showed Multiple Organisms

NO. OF DIFFRENT ORGANISMS ISOLATED	HCW's		Non HCW's	
	No.	f(%)	No.	f(%)
None (No growth)	3	6	10	20
1 Type	15	30	21	42
2 Type	20	40	18	36
3 or more type	12	24	4	8

Table.6 Comparison of Microbial Growth on Cell Phones of HCW's and Non HCW's

TYPE OF ORGANISM ISOLATED	HCW's		Non HCW's	
	No.=91	F (%)	No.=69	F (%)
GRAM (+ve)				
Staphylococcus aureus	19	38	26	52
Staphylococcus albus	25	50	16	32
Enterococcus sp.	3	6	1	2
GRAM (-ve)				
Klebseilla sp.	30	60	17	34
E.coli.	1	2	1	2
Pseudomonas	2	4	-	-
Candida albicans	4	8	3	6
GPB *	7	14	5	10
TOTAL	91	-	69	-

* GPB – Gram Positive Bacilli

Chandra *et al*., (2011) and these results were tied with our study. *Enterococcus* sps. are also a nosocomial pathogen and the number of *Enterococcus sp.* in our study was 6% which is higher (4.8%) than the study of Chandra *et al*., (2011).

In present study *E.coli* was found 2% in both HCW's and Non HCW's. But in contrast to this, *E.coli* was found 3.6% in the study of Karaby *et al*., (2007) (Table-6).

In a study of Arora *et al*., (2009) *Acinetobacter* spp. was isolated. Similar study conducted by Isaac *et al*., (1999) identified multidrug resistant *Acinetobacter* spp. in the cell phones and hands of the health care workers and patients admitted to the ICU. However, it is interesting that no *Acenitobacter* spp. is isolated in our study.

In total, the present study revealed that bacteria causing nosocomial infections are

present on mobile phones. These mobile phones are used inside and outside the hospital, so public also may get infections. In our study 37.36% of Microbes were found to be in technicians, which is lower than the study conducted by Chandra et. al. (2011) showed 54% of contamination rate in laboratories. (Table 8)

As observed most of the isolates obtained from cell phones of clinical workers in the study conducted by Arora *et al*. (2009) were showing growth of multi drug resistant organisms as compared to those isolated from non clinical sections. Where as in our study mobile phones were showing the growth of multi drug sensitive organisms both in HCW's and Non HCW's. Before decontamination in the present study,87% mobile phones showed growth and After decontamination with 70% isopropyl alcohol only 20% cell phones showed growth again. Thus proving the efficacy of decontamination. In the remaining phones, there was a significant reduction in the number of colonies but in the study conducted by Arora *et al*., (2009) the efficacy of decontamination with 70% isopropyl alcohol was found to be 98% as only 5 cell phones showed growth after decontamination. It was found that around 40% of the cell phones of health care workers were contaminated and thus acted as a potential source of nosocomial infections (Table 4).

A study was done by Ulger *et al*., 2009 showed that 49% of phones grew one bacterial species and 34% two different and 11.5% three or more different species and no bacterial growth were identified in 5.5% of phones. However, at our centre, 30% of phones grew one bacterial species, 40% two different species, 24% three or more different species and no bacterial growth were identified in 6% of phones of Health Care Workers and in case of Non Health Care Workers, It was found that 42% of phones grew one bacterial species, 36% two different species, 8% three or more different species and no bacterial growth were identified in 20% of phones (Table 5).

In our study 64% of contamination was found to be in technicians, which is higher than the study conducted by Chandra *et al*. (2011) showed 54% of contamination rate in laboratories technicians (Table 8).

Rusin *et al*. (2002) had documented transfer of both gram-positive and gram-negative bacteria during casual activities. Hence, the present findings imply that mobile phones may serve as vehicles of transmission of bacteria cause diseases such as diarrhea, pneumonia, boils and abscesses.

Antimicrobial susceptibility tests for the isolates revealed that Ciprofloxacin, Ofloxacin and Perfloxacin were found to inhibit 80.7%, 81.5% and 82.3% of the bacterial agents isolated, respectively. Ceftriaxone inhibited 79.0% of the organisms, while Amoxycillin was 100% effective against *P. aeruginosa* and moderately active against *Klebseilla* species (Akinyemi *et al*., 2009).

Similar results was found in Most of the antibiotics didn't used in our study but in case of *Pseudomonas,* it was found to be 100% resistant towards AN, AZ, PIT, and TOB (Table-14). In overall Fluoroquinolones and third-generation Cephalosporins are effective against most isolates in their study but at our centre Cephalosporins (CFP, CD) were quite sensitive to the bacteria isolated from mobile phones.

Table.7 Distribution of Bacterial Agents Isolated from HCW's

DEPARTMENT	*Staph. albus*		*Staph. aureus*		*Enterococc-us sp.*		*Klebseilla sp.*		*E.coli.*		*Peudom-onas*		*Candida albicans*		GPB	
	N	F %	N	F %	N	F %	N	F %	N	F %	N	F %	N	F%	N	F %
CCU	4	16	2	10.52	1	33.33	2	6.66	-	-	-	-	-	-	-	-
ICU	3	12	2	10.52	-	-	-	-	-	-	-	-	1	25	1	14.28
Burn unit	5	20	5	26.31	-	-	3	10	-	-	-	-	1	25	-	-
Male ward	2	8	3	15.78	-	-	4	13.33	-	-	-	-	-	-	1	14.28
Female ward	2	8	1	5.26	-	-	1	3.33	1	100	-	-	2	50	-	-
Emerg-ency	3	12	1	5.26	1	33.33	5	16.66	-	-	-	-	-	-	-	-
Microbi-ology lab	1	4	2	10.52	1	33.33	8	26.66	-	-	1	50	-	-	4	57.14
Blood bank	3	12	2	10.52	-	-	3	10	-	-	1	50	-	-	-	-
Central lab	2	8	1	5.26	-	-	4	13.33	-	-	-	-	-	-	1	14.28
Total	25		19		3		30		1		2		4		7	

Table.8 Total Frequency of Isolates in Departments

DEPARTMENT	TOTAL FREQUENCYOF ISOLATED ORGANISMS (%)
CCU	9.89
ICU	7.69
Burn unit	15.39
Male ward	10.98
Female ward	7.69
Emergency	9.89
Microbiology lab	18.68
Blood bank	9.89
Central lab	8.79
Total	100

Table.9 Antibiotic Sensitivity Pattern of *Staphylococcus albus*

DRUGS	SENSITIVITY	HCW's		Non HCW's	
		N=25	F (%)	N=10	F(%)
AN	S*	22	88	10	100
	I**	3	12	-	-
	R***	-	-	-	-
CF	S	17	68	9	90
	I	-	-	-	-
	R	8	32	1	10
PIT	S	24	96	7	70
	I	-	-	2	20
	R	1	4	1	10
CD	S	23	92	9	90
	I	1	4	1	10
	R	1	4	-	-
OX	S	20	80	8	80
	I	-	-	1	10
	R	5	20	1	10
CFP	S	22	80	10	100
	I	3	12	-	-
	R	-	-	-	-
G	S	19	76	9	90
	I	1	4	1	10
	R	5	20	-	-
TOB	S	18	72	10	100
	I	2	8	-	-
	R	5	20	-	-
TCC	S	17	68	10	100
	I	2	8	-	-
	R	6	24	-	-
AZ	S	20	80	10	100
	I	2	8	-	-
	R	3	12	-	-
AMP	S	21	84	10	100
	I	1	4	-	-
	R	3	12	-	-
VA	S	24	96	10	100
	I	-	-	-	-
	R	1	4	-	-

* S – Sensitive
** I – Intermediate
*** R – Resistant

Table.10 Antibiotic Sensitivity Pattern of *Staphylococcus aureus*

DRUGS	SENSITIVITY	HCW's		NON HCW's	
		N=19	F(%)	N=16	F(%)
AN	S*	15	78.94	16	100
	I**	2	10.5	-	-
	R***	2	10.5	-	-
CF	S	13	68.42	13	81.25
	I	-	-	2	12.25
	R	6	31.57	1	6.25
PIT	S	14	73.68	15	93.75
	I	2	10.5	-	-
	R	3	15.78	1	6.25
CD	S	8	42.10	12	75
	I	2	10.5	3	18.75
	R	9	47.36	1	6.25
OX	S	7	36.82	12	75
	I	-	-	1	6.25
	R	12	63.15	3	18.75
CFP	S	13	68.42	16	100
	I	1	5.2	-	-
	R	5	26.31	-	-
G	S	15	78.94	16	100
	I	-	-	-	-
	R	4	21.05	-	-
TOB	S	10	52.63	16	100
	I	-	-	-	-
	R	9	47.36	-	-
TCC	S	5	26.31	15	93.75
	I	1	5.2	1	-
	R	13	68.42	-	-
AZ	S	10	52.63	13	81.25
	I	-	-	-	-
	R	9	47.36	3	18.75
AMP	S	3	15.78	12	75
	I	2	10.5	-	-
	R	14	73.68	4	25
VA	S	17	89.47	16	100
	I	1	5.2	-	-
	R	1	5.2	-	-

* S – Sensitive
** I – Intermediate
*** R – Resistant

Table.11 Antibiotic Sensitivity Pattern of *Enterococcus sp*

DRUGS	SENSITIVITY	HCW'S		NONHCW'S	
		N=3	F(%)	N=1	F(%)
AN	S *	-	-	1	100
	I **	-	-	-	-
	R***	3	100	-	-
CF	S	1	33.33	1	100
	I	-	-	-	-
	R	2	66.66	-	-
PIT	S	1	33.33	1	100
	I	-	-	-	-
	R	2	66.66	-	-
CD	S	-	-	-	-
	I	-	-	-	-
	R	3	100	1	100
OX	S	-	-	1	100
	I	-	-	-	-
	R	3	100	-	-
CFP	S	1	33.33	1	100
	I	-	-	-	-
	R	2	66.66	-	-
G	S	-	-	1	100
	I	-	-	-	-
	R	3	100	-	-
TOB	S	-	-	1	100
	I	-	-	-	-
	R	3	100	-	-
TCC	S	-	-	1	100
	I	-	-	-	-
	R	3	100	-	-
AZ	S	-	-	1	100
	I	-	-	-	-
	R	3	100	-	-
AMP	S	-	-	1	100
	I	-	-	-	-
	R	3	100	-	-
VA	S	-	-	1	100
	I	-	-	-	-
	R	3	100	-	-

* S – Sensitive
** I – Intermediate
*** R –Resistant

Table.12 Antibiotic Sensitivity Pattern of *Klebseilla sp*

DRUGS	SENSITIVITY	HCW's		Non HCW's	
		N=30	F(%)	N=12	F(%)
AN	S*	25	83.33	11	91.66
	I**	1	3.33	-	-
	R***	4	13.33	1	9.09
CF	S	25	83.33	7	58.33
	I	-	-	3	25
	R	5	16.66	2	16.66
PIT	S	24	80	11	91.66
	I	2	6.66	-	-
	R	4	13.33	1	9.09
CD	S	12	40	9	75
	I	3	10	3	25
	R	15	50	-	-
OX	S	16	53.33	9	75
	I	1	3.33	3	25
	R	18	60	-	-
CFP	S	22	73.33	10	83.33
	I	1	3.33	2	16.66
	R	7	23.33	-	-
G	S	10	33.33	12	100
	I	1	3.33	-	-
	R	19	63.33	-	-
TOB	S	16	53.33	11	91.66
	I	-	-	-	-
	R	14	46.66	1	9.09
TCC	S	10	33.33	11	91.66
	I	2	6.66	-	-
	R	18	60	1	9.09
AZ	S	22	93.33	10	83.33
	I	2	6.66	-	-
	R	6	20	2	16.66
AMP	S	4	13.33	8	66.66
	I	1	3.33	-	-
	R	25	83.33	4	33.33
VA	S	14	46.66	10	83.33
	I	1	3.33	-	-
	R	15	50	2	16.66

* S – Sensitive
** I – Intermediate
*** R - Resistant

Table.13 Antibiotic Sensitivity Pattern of *E.coli*

DRUGS	SENSITIVITY	HCW's		Non HCW's	
		N=1	F(%)	N=1	F(%)
AN	S*	1	100	1	100
	I**	-	-	-	-
	R***	-	-	-	-
CF	S	1	100	1	100
	I	-	-	-	-
	R	-	-	-	-
PIT	S	1	100	1	100
	I	-	-	-	-
	R	-	-	-	-
CD	S	1	100	1	100
	I	-	-	-	-
	R	-	-	-	-
OX	S	1	100	-	-
	I	-	-	-	-
	R	-	-	1	100
CFP	S	-	-	1	100
	I	-	-	-	-
	R	1	100	-	-
G	S	1	100	1	100
	I	-	-	-	-
	R	-	-	-	-
TOB	S	1	100	1	100
	I	-	-	-	-
	R	-	-	-	-
TCC	S	-	-	1	100
	I	1	100	-	-
	R	-	-	-	-
AZ	S	1	100	1	100
	I	-	-	-	-
	R	-	-	-	-
AMP	S	1	100	1	100
	I	-	-	-	-
	R	-	-	-	-
VA	S	1	100	1	100
	I	-	-	-	-
	R	-	-	-	-

* S – Sensitive
** I – Intermediate
*** R – Resistant

Table.14 Antibiotic Sensitivity Pattern of *Pseudomonas*

DRUGS	SENSITIVITY	HCW's		Non HCW's	
AN	S *	2	100	-	-
	I**	-	-	-	-
	R***	-	-	-	-
CF	S	-	-	-	-
	I	-	-	-	-
	R	2	100	-	-
PIT	S	2	100	-	-
	I	-	-	-	-
	R	-	-	-	-
CD	S	-	-	-	-
	I	-	-	-	-
	R	2	100	-	-
OX	S	-	-	-	-
	I	-	-	-	-
	R	2	100	-	-
CFP	S	-	-	-	-
	I	1	50	-	-
	R	1	50	-	-
G	S	-	-	-	-
	I	-	-	-	-
	R	2	100	-	-
TOB	S	2	100	-	-
	I	-	-	-	-
	R	-		-	-
TCC	S	-	-	-	-
	I	-	-	-	-
	R	2	100	-	-
AZ	S	2	100	-	-
	I	-	-	-	-
	R	-	-	-	-
AMP	S	-	-	-	-
	I	-	-	-	-
	R	2	100	-	-
VA	S	-	-	-	-
	I	-	-	-	-
	R	2	100	-	-

* S – Sensitive
** I – Intermediate
*** R - Resistant

Table.15 Over All Sensitivity of Microbes

DRUGS	HCW's	Non HCW's
AN	81.25	63.3
CF	71.25	50.81
PIT	82.5	57.37
CD	55	50.81
OX	55	49.18
CFP	72.5	62.29
G	56.25	63.93
TOB	56.25	63.93
TCC	40	62.29
AZ	68.75	57.37
AMP	36.25	59.01
VA	70	62.29

The present study demonstrated that resistant rates to commonly used antimicrobials in isolated bacteria from phones varied from 17.50% for PIT to 63.75% for AMP in HCW's and in Non HCW's, it is varied from 36.03% for G and TOB to50.85% for OX, which is higher than the study conducted by Sepehri *et al*., (2009), the resistance rates to commonly used antimicrobials in isolated bacteria from phones varied from 6.7% for Cephalothin to 25% for Amoxycillin. Resistance to Gentamicin in their study was 15.6%.It was found that about 79% of bacteria isolated from phones were sensitive to all three antibiotics used in that study and 4.4% were resistant to all of these antibiotics. They didn't use those antibiotics which are used in our study except Gentamicin (Table.15).

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References

Akinyemi, K.O., Atapu, A.D., Adetona, O.O. and Coker, A.A.O. 2009. The potential role of mobile phones in the spread of bacterial infections. J. Infect. Dev. Ctries. 3 (8): 628-632.

Arora, U., Devi, P., Chadha,A. and Malhotra,S.2009.Cellphones a modern stay house for bacterial pathogens. J.K. Scie. 11 (3): 127-129.

Bauer, A.W., Kirby, M., Sheris, J.D. and Turch, M.1966.Antibiotic susceptibility testing by standard single disc method. Amer. J. Clin. Pathol.45: 493–496

Brady, R.R., Fraser, S.F., Dunlop, M.G., Paterson Brown, S. and Gibb, A.P. 2007. Bacterial contamination of mobile communication devices in the operative environment. J. Hosp. Infect. 66: 397-8.

Chandra, T.J., Prasanna, T.L. and Rao, A.V. 2011. A study on isolation and identification of bacteria causing nosocomial infections on mobile phones of health care workers. Calicut Med. J. 9 (1): e2.

Chawla, K., Mukhopadhayay, C., Gurung, B., Bhate, P. and Bairy, I. 2009. Bacterial 'Cell' Phones: Do cell phones carry potential pathogens? Online J. Health Allied Scie. 8 (1): 8.

Ekrakene, T. and Igeleke, C. L. 2007. Microorganisms associated with public mobile phones along benin-sapele express way. J. Appl. Scie. Res.3 (12): 2009-2012.

Elmer, W.K., Stephen, D.A., William, M.J. and Schreckenberger, C. and Washingtone, C.W. 1997. Antimicrobial susceptibility testing in Colour atlas and text book of diagnostic microbiology.5th edition. 227 East Washington Square, Philadelphia. Raven Publisher: 69–120.

Karabay, O., Koçoglu, E., and Tahtaci, M. 2007.The role of mobile phones in the spread of bacteria associated with nosocomial infections. J. Infect. Developing Countries 1 (1): 72-73.

Mackie Mc Cartney by J.P.Dugui, B.P. Marimon; R.H.Aswain, A.G.Fraser. Chapter7, page 131, Chapter20, page 361-384,14edition.

Rusin, P., Maxwell, S. and Gerba, C. 2002. Comparative surface-to-hand fingertip to-mouth transfer efficiency of gram-positive bacteria, gram negative bacteria and phage. J. Appl. Microbiol. 93: 585-592.

Sepehri, G., Talebizadeh, N., Mirzazadeh, A., Mir-shekari, T. and Sepehri, E. 2009. Bacterial contamination and resistance to commonly used antimicrobials of healthcare workers' mobile phones in teaching hospitals, Kerman, Iran. American J. App. Scie. 6 (5): 693-697.

Singh S, Acharya S, Bhat M, Rao SK, Pentapati KC. Mobile phone hygiene: potential risks posed by use in the clinics of an Indian dental school. J Dent Educ 2010; 74(10): 1153-1158.

Tambekar, D.H., Gulhane, P.B., Dahikar, S.G. and Duhdane, M.N. 2008. Nosocomial hazards of Doctor's mobile phones in hospitals. J. Med. Sci. 8 (1): 73 -76.

Ulger, F., Essen, S., Dilek,A., Yanik, K., Gunaydin,M. and Leblebicioglu, H. 2009. Are we aware how contaminated our mobile phones are with nosocomial pathogens? Ann. Clin. Microbiol. Antimirob. 8: 7.