

## Contamination Rate of Mobile Phones and Hands of Nursing Staff in ICUS with Assessment on Their Awareness of Mobile Cleanliness.

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### I. Introduction

Today, mobile phones have become one of the most essential adornments of professional and social life. In spite of that they are generally stored in bags or pockets<sup>(1,2)</sup> as mobile phones act as perfect habitats for microbes to breed, especially in high temperatures and humid conditions. During every phone call a mobile phone comes into close contact with contaminated human body areas such as hands, and also portals of entry such as the mouth, nose and ears<sup>(3)</sup>. Cell phones can become an exogenous source of nosocomial infection among hospitalized patients<sup>(4)</sup>. The avenue of transfer is the presence of microorganisms on mobile phones which are carried by all medical staff, large numbers of nursing staff, and also transferred from person to person or from inanimate objects (such as stethoscopes, bronchoscopes, pagers, ballpoint pens, hospital charts, computer keyboards, mobile phones and fixed telephones) to hands and vice versa<sup>(5)</sup>.

Gram positive bacteria like *Staphylococcus aureus*, CoNS, ASB and Diptheroids constituted of major fraction. Among all gram positive bacteria, the most common isolated bacteria were *Staphylococcus species*<sup>(6)</sup>. *Staphylococcus aureus*; and the coagulase-negative staphylococci (CoNS), both are common commensals of the skin. *S. aureus* is the most pathogenic species of the genus *Staphylococcus*, being occupied in both community-acquired and hospital acquired infections<sup>(7,8,9)</sup>. They resist drying and can live and multiply quickly in the warm environments like mobile phones<sup>(10)</sup>. All strains of *Staphylococcus aureus* including MRSA and MSSA were harmful for human and these cause infection. MRSA is a multidrug resistant and responsible for the several difficult-to-treat infections in humans<sup>(11)</sup>.

The gram negative bacteria like *E.coli*, Acinetobacter, Klebsiella and Pseudomonas which may live for sufficient period of time on the hand and may thus serve either as a reservoir or housing of infection<sup>(12)</sup>. Organisms like *E. coli*, Klebsiella etc. are important cause of nosocomial gram negative sepsis<sup>(11)</sup>. Acinetobacter survives on wet environment<sup>(13)</sup>. Acinetobacter spp. and Pseudomonas are environmental inhabitants but occur life threatening infections in susceptible patients<sup>(11)</sup>. The restriction of mobile phones use in hospital is not an effective method for control of infections. Therefore appropriate hand and body hygiene is very important. With 70% of isopropyl alcohol can reduce the bacterial infections<sup>(14)</sup>.

The aim of present study was to know the contamination rate of mobile phones and hands of nursing staff in ICUs with assessment on their awareness of mobile cleanliness.

### II. Material And Methods

#### Study subjects:-

The present study conducted on 250 nursing staffs from different ICUs of MMIMSR, Mullana, Ambala during a period of one year. The study was carried out in the Department of Microbiology, Maharishi Markandeshwar Institute of Medical Science And Research for a period of six months.

#### Specimen collection, transport

Two samples were taken, one from mobile phones and one from hands from each nurse. Sterile cotton swab sticks were rotated on the keypads, screen, outer surface of mobile. Same procedure done on hands with another cotton swab and stored into a tube containing normal saline. After collection, immediately transported to the microbiology lab.



**Laboratory protocol**

**Culture:** All swabs were culture on nutrient agar plates, blood agar and Macconkey agar and incubated overnight at 37 °C for 24 hours.

**Identification of growth:** - Based on the gram’s staining, colony morphology and appropriate biochemical tests isolates were identified by standard methods.

Biochemical test for **Gram Negative isolates** were catalase test, oxidase test, indole test, citrate test, urease test and TSI test.

Biochemical test for **Gram positive isolates** are Catalase test, modified oxidase test, Coagulase test.

**Antimicrobial sensitivity testing according to CLSI guidelines:** - using muller hinton agar. Different isolates were swabbed on the surface of the agar completely to make a lawn. Antibiotic disc were applied using sterile forceps. The plates were incubated at 37 °C for 24 hrs. After 24 hours, the zone of inhibition has been observed and recorded. Antibiotic used for testing susceptibility against Gram Negative isolates: - Gentamicin, Amikacin, Tobramycin, Ciprofloxacin, levofloxacin, Ampicillin, Cefixime, Imepenem, Meropenem, Cotrimoxazole, Tetracycline, Minocycline.

Antibiotic used for testing susceptibility against Gram positive isolates: - Gentamicin, Ciprofloxacin, levofloxacin, penicillin, Vancomycin, Linezolid, Azithromycin, Erythromycin, Clindamycin, Cefoxitine.

**III. Results**

**TABLE I:** Distribution of growth pattern from samples.

<b>Pattern</b>	<b>Phones</b>	<b>Hands</b>
Number of samples showing Growth	196 (78.4%)	213 (85.4%)
Number of samples showing No growth	54 (21.6%)	37 (14.8%)
Total number of samples screened	250	250

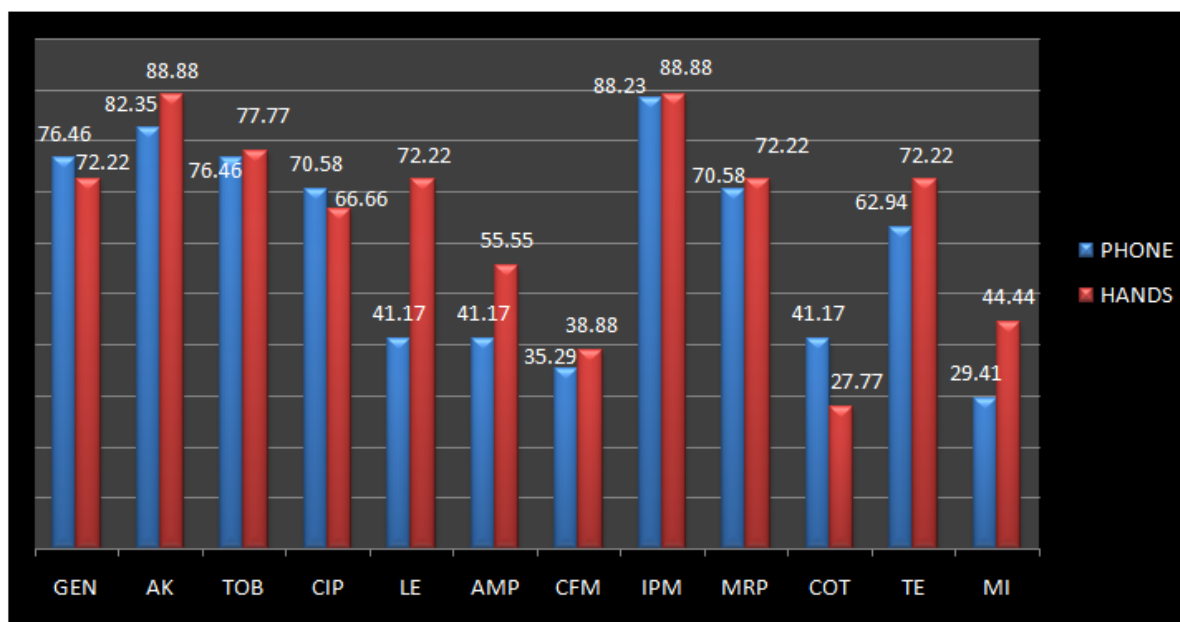
TABLE I- Illustrates the distribution of growth pattern from mobile phones and hands. Out of 250 samples, 196(78.4%) showed growth in phones and 213(85.4%) in hands while 54(21.6%) were sterile in phones and 37(14.8%) in hands.

**TABLE II:** Distribution of organisms on the basis of gram staining in mobile phones and hands.

Types of organism isolated	Organism	Phones	Hands
Gram positive bacteria	MSSA	55 (37.6%)	63 (45.6%)
	CoNS	48 (32.8%)	34 (24.63%)
	MRSA	24 (16.4%)	21 (15.2%)
	ASB	12(8.21%)	17 (12.3%)
	Diphtheroids	8(5.4%)	5(3.6%)
	Total	146	138
Gram negative bacteria	E.coli	17(34.0%)	25(33.3%)
	Acinetobacter	14 (28.0%)	12 (16.0%)
	Pseudomonas	12 (24.0%)	20 (26.6%)
	Klebseilla	6 (12.0%)	17 (22.6%)
	Total	50	75

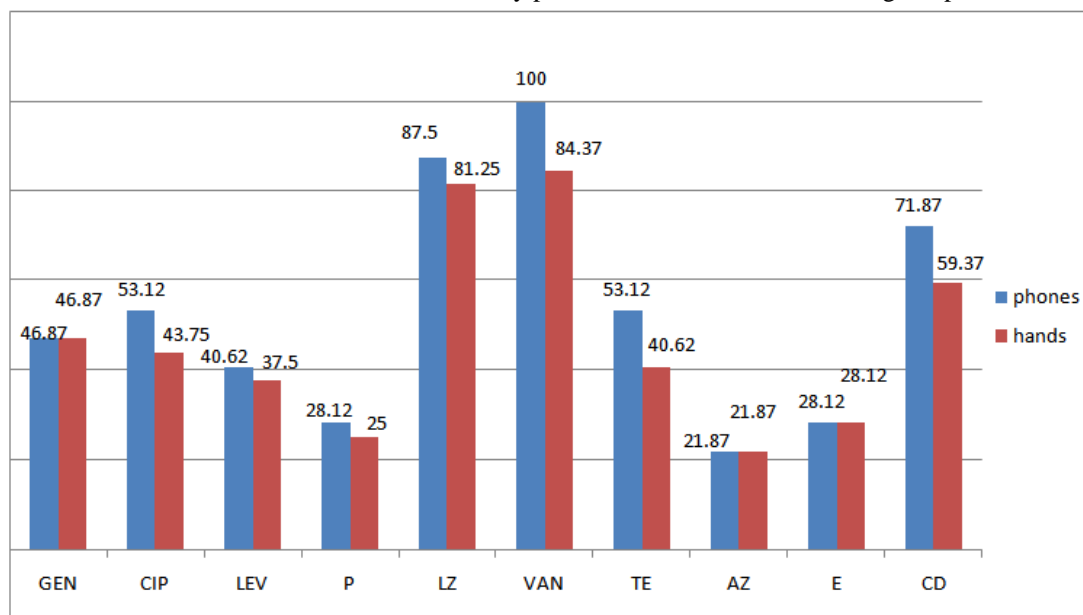
**Table-II** shows the distribution of organisms of gram positive bacteria and gram negative bacteria. The total numbers of gram positive bacteria were 146 in phones and 138 in hands. Total numbers of gram negative bacteria were 50 in phones and 75 in hands.

**FIGURE III:** Distribution of Antibiotic Sensitivity pattern in Phones and Hands for gram negative isolates.



**FIGURE III:** Shows antibiotic sensitivity pattern of gram negative organisms in phones and hands. In phones:- it has been found that in Gram negative bacteria(E.coli, Acinetobacter, klebsiella, pseudomonas) were highly sensitive to imipenem 88.88%, amikacin 82.35% .  
**In hands:-** showed highly sensitive to imipenem 88.88% , amikacin 88.88%.

**FIGURE IV:** Distribution of Antibiotic Sensitivity pattern in Phones and Hands for gram positive isolates.



**FIGURE IV:** Shows antibiotic sensitivity pattern of gram positive organisms in phones and hands.  
 In phones :- In gram positive bacteria(*Staphylococcus species* and CoNS) showed Linezolid 87.5% and 100% for vancomycin followed by Clindamycin 71.87%.  
 In hands:- In gram positive bacteria(*Staphylococcus species* and CoNS) showed Linezolid 81.25%, and 84.37% for vancomycin.

**TABLE V:** Evaluation of the questions regarding phones in nursing staff.

	Yes	No
Do you know that Phones can act as a source of infection in hospital	238 (95.2%)	12 (4.8%)
Do you Use mobiles in hospital	250 (100%)	0
Do you Wash your hands after handling the patients	175 (70%)	75 (30%)
Do you remove your gloves while receiving calls	125 (50%)	125 (50%)
Do you clean your mobile phone	75 (30%)	175 (70%)

**Table V:** General awareness regarding the use of mobile phones in nursing staff was evaluated by circulating a printed questionnaire. Here we found to be that 95.2% of nursing staff have the knowledge regarding the infection caused by mobile phones via hands in hospital environment. In our study 100% of nurses use their mobiles in hospital and during work time 70% of nurses wash their hands before and after handling the patients. With the help of this questionnaire we found to be that 50% of nurses remove their gloves while receiving any phone calls and 30% of nurses clean their mobile phones.

#### IV. Discussion

Out of 250 nurses which were enrolled in the study, 196(78.4%) showed growth in phones and 213(85.4%) in hands while 54(21.66%) were reported sterile in phones and 37(14.8%) in hands. (TABLE - I) Hence, the rate of contamination of mobile phones in the present study was found to be 78.33% and the rate of contamination was 85% in the hands. This correlates with the study conducted by Dr. Harish .R. Trivedi et al(2011) [15] where out of 150 samples, 46.66% showed growth in phones and 58.66% in hands. Another study done by Vincenza La Fauci et al (2014) [16] in their study from the hospital, 78% of cell phones and 86% of hands were found to be contaminated. And Gholamreza Sepehri et al (2009) [17] found that out of 150, 48(32%) of their mobile phones and 59(39.33%) of dominant hands had bacterial contamination. The higher rate of isolation in the present study could be due to lack of awareness of cleaning of hands and phones and also because of poor hygiene.

During study period, Gram positive bacteria were predominantly isolated in both phones 146(74.4%) and in hands 138(64.7%) (TABLE-II) . Similarly Chin-Hsiang Chang et al (2017)<sup>[18]</sup> reported that the Gram positive bacteria were predominant than gram negative bacteria. Tolossa E Chaka et al (2016)<sup>[19]</sup> showed the higher rate of gram positive bacteria. Among the Gram positive bacteria, CONS, *S.aureus* ,Diphtheroids and ASB constituted of major fraction since Diphtheroids and CONS are the normal skin commensals and they multiply rapidly in the warm environments like the mobile phones . ASB are the rich in environment so that is the reason that mobile phones are more contaminated than hands. *Staphylococcus spp.* which is commonly associated with the nosocomial infection further, it is most common pathogen in human bodies causing tissue infections, septicemia and device associated infection and it can be transmitted from the person to person and results in colonization of samples.

In the present study, the most common bacteria isolated from the phones and hands were *Staphylococcus spp.* In phones, *S.aureus* constituting 79(40.30%) (MRSA-24, MSSA- 55) and CONS contributed to 48(24.48%) out of total 196 organism isolated. In hands, *S.aureus* constituting 84(39.43%) (MRSA-21, MSSA -63) and CONS contribute to 34(15.9%) out of 213 organism isolates. This study slightly related with the Raghavendra Rao Morubagal et al (2017)<sup>[20]</sup> study where out of 125 mobile phones, *Staphylococcus spp.* 90(43.68%)were highly isolated organism .In which MSSA 34(16.64%) was slightly higher than MRSA 31(15.27%). (TABLE-II) The high rate of MSSA is due to the environmental factor. This study slightly contrasts with the finding of Shivakumar M. Channabasappa et al (2016) <sup>[21]</sup> where CONS (36%) were most prevalent bacteria followed by MSSA. DR.HARISH R TRIVEDI et al (2011)<sup>[15]</sup> indicated that50% of isolated *S.aureus* was MRSA. As the normal flora, usually human skin contains *Staphylococcus spp.* These organisms found their mode through the skin. *S.aureus* and CONS mainly survives on dry surface and multiply rapidly in warm environment like phones. In hospital, during work time, constant handling of mobile phones by nursing staff and during receiving the phone calls heat is generated that is the good medium for the growth of microorganisms. The isolation of Diphtheroids in mobile phones points towards the fact that these bacteria are the normal commensals of the hands and can colonize the mobile phones. The high rate of *S. aureus* in this study may be because of increasing optimum temperature as phones are kept in the pockets, and also in handbags. In the present study, *E.Coli* and *Acinetobacter sp.* were found to be the commonest gram negative bacilli. The presence of *E.coli* and *Klebsella spp.* is due to the fecal contamination of phones. Poor hand washing after fecal discharge leads to absorption of bacteria into hands and nails via phones.(TABLE-II) This study correlates with the Oguz Karabay et al(2007) <sup>[22]</sup> study where *E.coli spp.* was reported as the predominant isolates during study period. In contrasts JAGDISH LAVANYA et al (2015)<sup>[23]</sup> and Neha Sharma et al(2014)<sup>[14]</sup> found klebsella *spp.*as the predominant gram negative organism. In the present study, this could be explained by the fact that *Acinetobacter sp.* survives better on wet environment. The higher occurrence of *Acinetobacter sp.* could be due to the constant handling of phones, warmth of the body, handbags, further potentiates the growth, colonization and proliferation of this infectious pathogen. Sweat of the hand and other body parts in a tropical area is also another good media for growth of bacteria.

GNB shows the higher number of susceptibility to Amikacin and Imipenem. The least sensitivity seen against ampicillin and cotrimaxazole (FIG. III) .This study highly correlates with the study of KUH PAL et al (2015) <sup>[24]</sup> where Amikacin showed good sensitivity pattern and they also reported that the gram negative isolates were resist to ampicillin, ceftriaxone and cotrimaxazole. In contrast JAGDISH LAVANYA et al(2015)<sup>[23]</sup>reported in their study that levofloxacin and meropenem showed the good sensitivity pattern followed by imipenem and cotrimaxazole. In their study amikacin showed the least sensitivity against gram negative organisms.

In present study, Linezolid and Vancomycin were most effective drugs against gram positive bacteria followed by Clindamycin (FIG IV). This correlated with the finding of VIRENDRA S KOHLE et al (2014)<sup>[25]</sup>where 100% sensitivity to *S.aureus* against Vancomycin and Linezolid was observed. The study highly contrast with the finding of DERESE DAKA(2014) <sup>[26]</sup> where the resistant level of *S.aureus* to Ciprofloxacin were low as compared to Vancomycin and penicillin.

In the present study, we found that 95% of the nurses have the knowledge regarding the role of mobile phones as a source of infection in average to fair range. (TABLE-V) This study correlated with the finding of Abubakar et al (2015)<sup>[27]</sup> where over 70% of the respondents have their level of knowledge on the use of mobile phone for knowledge update as average or better . This indicates that nurses have the knowledge about use of mobile phone.

## V. Conclusion

The contamination rate of mobile phones and hands of nursing staff in ICUs was high. *Staphylococcus species* were the most common isolates in both hands and phones. Nurses had adequate knowledge regarding role of mobile phones as a carrier of infections and also about cleaning techniques.

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