

## Level of Contamination and Antibiotic Resistance of Bacterial Isolates from Mobile Phone of HCW's in Hawassa Referral Hospital

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**Abstract:** The etiological agents of Nosocomial infections may spread through the hands of healthcare workers and other instruments. Objective: The objective of this study was to determine the contamination rate of the health care workers mobile phones in the Hawassa referral Hospital. Method: 152 Mobile phones was randomly sampled from wards, laboratory, ICU and operating rooms of doctors, nurses, Laboratory Technologists and other healthcare staffs were screened. The standard microbiological analysis was done. Results: The rate of bacterial contamination of mobile phones was 97.4%. It was found that 50.6% of phones grew one bacterial species, 25.0% two different species, 24.8% three or more different species and no bacterial growth were identified in 2.6% of phones. The bacterial species that isolated from mobile phone and hands of the HCW's was *S. aureus*, CoNS, *Streptococcus* spp, *E. coli*, *K. pneumonia*, *Proteus* spp, *Citrobacter* spp, *Shigella* spp and *P. aeruginosa*. Ampicillin and Penicillin was less effective against the identified bacteria, whereas, Gentamicin, Ceftriaxone, Doxycycline and Ciprofloxacin were most effective. Conclusion: Our study reveals that mobile phones may contaminate by different pathogenic bacteria which can cause nosocomial infection. It is needed to minimize the risk of mobile phones as vectors for pathogen transmission.

**Keywords:** Hand of health worker, mobile, nosocomial infection

### INTRODUCTION

Nosocomial infections increases gradually time to time and such infections cause a significant rate of mortality and morbidity. The etiological agents of hospital acquired infections may spread through the hands of HCWs, thermometers, stethoscopes and even toys in the pediatric ICUs of hospitals (Singh *et al.*, 1998).

In addition, nosocomial infection is an important problem in all modern hospitals. As early as 1861 Semmelweis (Semmelweis, 1861) demonstrated that bacteria were transmitted to the patients by the contaminated hands of healthcare workers. Hospital Operating Rooms (OR) and Intensive Care Units (ICU) are the workplaces that need the highest hygiene standards, also the same requirements for the personnel working there and the equipment used by them. Some epidemiological studies have implicated environmental surfaces in the transmission of bacteria (Ekanem *et al.*, 1983, Bures *et al.*, 2000, Manning *et al.*, 2001).

Today, mobile phones have become one of the indispensable accessories of professional and social life in Ethiopia. The use of cell phones often occurs in hospital halls, laboratories and/or Intensive Care Units (ICU) when dealing with severe illnesses. In here Hawassa referral hospital mobile phones are widely used as nonmedical portable electronic devices and it is

in close contact with the body. It is used for communication by health care workers in every location including OR and ICU (Wikler, 2006).

As its valuable contribution mobile phone is also negatively influencing in contribution of microorganisms. However, it is not clear whether such accessories have a role to play in the spread of bacteria. Even though, the risk of infection involved in using mobile phones in the OR, ICU, Laboratory rooms, outpatient departments and wards has well determined there is no cleaning guidelines in Hawassa referral hospital that meet hospital standards. However, the mobile phones are used routinely all day long but not cleaned properly, as health care workers' (HCW) may do not wash their hands as often as they should. Therefore, the aim of this study is to determine the contamination and antibiotic resistance level of microorganisms in mobile phone from HCWs', in different work place at Hawassa University referral Hospital.

### METHODS AND MATERIALS

**Study Area, Design and population:** The cross-sectional study was conducted on Hawassa University at college of Medicine and Health science at referral hospital where 152 Mobile phones was randomly sampled from, wards, laboratory, ICU and operating

rooms of senior doctors, GP doctors, nurses, Laboratory Technologists and other healthcare staff-was screened.

A sample of size 152 was determined using sample size calculator in EPI info of by setting CI at 95%, margin of error at 3% considering magnitude of mobile phone contamination to be 95% from a previous study.

Total collected samples culture was subsequently obtained from the dominant hand of participants and their mobile phones at the same time. Gender, profession and duration of their profession, ring use, dominant hands of HCWs, routine cleaning of the mobile phones was recorded.

A sterile swab moistened with sterile saline was rotated over the surface of both sides of mobile phones; second swab was rubbed over the entire ventral surface of the dominant hand (including ventral surfaces of the thumb and the fingers) of HCW's.

**Bacterial identification:** The sampling of the dominant hand and mobile phone swabs (twice for hands and twice for mobile phones) was immediately streaked onto two plates that consist of blood agar supplemented with 5% defibrinated sheep blood and eosin methylene blue agar. Plates were incubated aerobically at 37°C for 48h. Isolated microorganisms was identified using gram stain, colony counts, morphology, catalase and oxidase reaction and all isolates were allocated to the appropriate genera. For identification of gram negative bacteria MacConkey agar and other biochemical tests such as Triple Sugar Iron agar, Citrate agar, Lysine Iron agar, Urea broth, Motility test medium and Indol test was used. A slide coagulase test differentiated staphylococcal isolates into *Staphylococcus aureus* and coagulase-negative staphylococci (CoNS). Vancomycin sensitivity of the *Staphylococcus aureus* isolates were investigated by disk diffusion method according to

Clinical Laboratory Standards (CLSI) criteria (Wikler, 2006).

Statistical analyses were performed by using SPSS version 17.0 software program. A p-value of <0.05 was considered indicative of a statistically significant.

**Antimicrobial susceptibility:** Antibiotic susceptibility tests were performed on all isolated bacteria to determine their antibiotic-resistance profiles (Kirby *et al.*, 1966). An aliquot (100µL) from each isolate suspension was spread plated on Mueller Hinton agar (supplied by Oxoid Company). Susceptibilities of the isolates to a panel of eleven different antibiotic discs were determined. Antibiotic discs were gently pressed onto the inoculated Mueller Hinton agar to ensure intimate contact with the surface and the plates were incubated aerobically at 37°C for 18-24 h (National Committee for Clinical Laboratory Standards (NCCLS), 1999). Inhibition zone diameters were measured and values obtained from the National Committee on Clinical Laboratory Standards (National Committee for Clinical Laboratory Standards (NCCLS), 1999) were used to interpret the results obtained.

## RESULTS

The rate of bacterial contamination of mobile phones was 97.4%. The most common bacterial species that isolated from mobile phone and hands of the HCW's were *S. aureus*, coagulase negative *Staphylococcus* (CoNS), *Streptococcus* spp, *E. coli*, *K. pneumonia*, *Proteus* spp, *Citrobacter* spp, *Shigella* spp and *P. aeruginosa* which is similar in both mobile

Table 1: The types of bacteria isolated from phones and hands of HCW

| Bacteria |                              | Mobile phone (n = 152) | Hands of HCWs (n = 152) |
|----------|------------------------------|------------------------|-------------------------|
| Gram+    | <i>S. aureus</i>             | 82(53.9%)              | 84(55.3%)               |
|          | CoNS                         | 128(84.2%)             | 142(93.4%)              |
|          | <i>Streptococcus</i> spp     | 12(7.9%)               | 14(9.2%)                |
| Gram -   | <i>E. coli</i>               | 24(15.8%)              | 25(16.4%)               |
|          | <i>Klebsiella pneumoniae</i> | 19(12.5%)              | 17(11.2%)               |
|          | <i>Proteus</i> spp           | 19(12.5%)              | 21(13.8%)               |
|          | <i>Citrobacter</i> spp       | 6(3.95%)               | 4(2.6%)                 |
|          | <i>Shigella</i> spp          | 7(4.61%)               | 7(4.6%)                 |
|          | <i>P. aeruginosa</i>         | 20(13.2%)              | 22(14.5%)               |
| Total    |                              | 299                    | 208                     |

CoNS (Coagulase negative Staphylococci), \*: More than one type of bacterial growth was seen in some mobile phones

Table 2: Hand contamination rate of HCWs and colony count with or without ring

| Profession                  | N (Mean ± SD) | Ring using staff<br>Mobile phone's<br>(Mean ± SD) | Non ring using staff<br>Mobile phone's<br>(Mean ± SD) | p-value |
|-----------------------------|---------------|---|---|---------|
| Nurse                       | 67(21.0±38.2) | 28.8±39.4   | 24±38.0   | >0.05   |
| Laboratory tech             | 34(31.0±39.9) | 30.1±38.3   | 27±39.0   |         |
| General practitioner (Dr)   | 12(21.0±38.2) | 26.8±39.4   | 24±38.0   |         |
| Senior doctors              | 10(11.8±16.1) | 17.4±23.4   | 10.43±28.5  |         |
| Other healthcare personnel* | 16(20.0±42.2) | 29.2±69.4   | 25.5±24.0   |         |

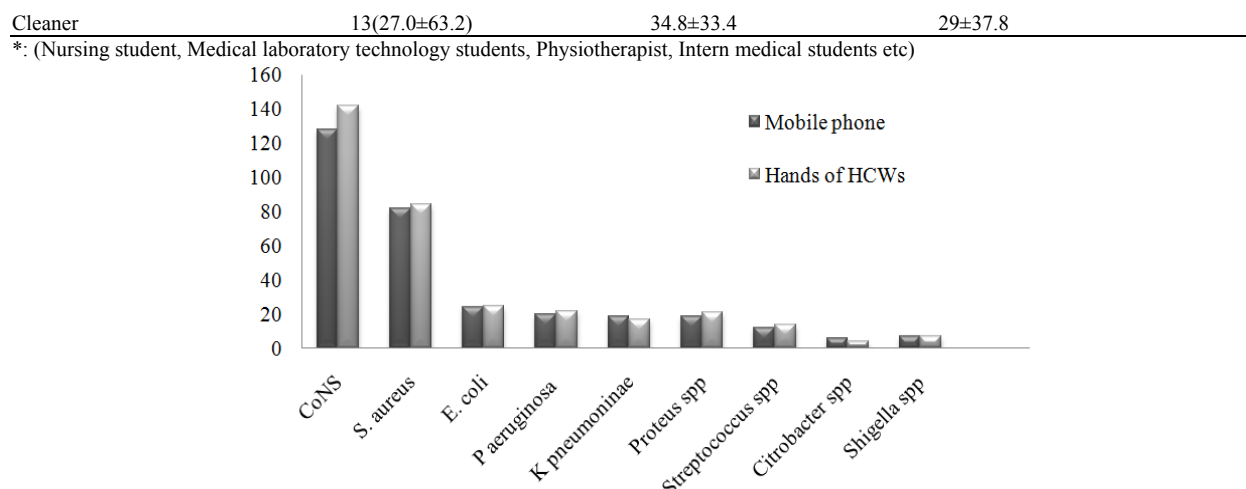


Fig. 1: Bacterial agents Isolated from Mobile phone and HCWs Hands

phones and hands of HCW's (Table 1). Also different bacterial agents isolated from mobile phone and HCWs Hands were mentioned in Fig. 1. Some of them are known to cause nosocomial infections. Hand contamination rates of HCWs and their personal mobile phones are shown in Table 2. It was found that 50.6% of phones grew one bacterial species, 24.0% two different species, 22.8% three or more different species and no bacterial growth were identified in 2.6% of phones. Those *S. aureus* strains isolated from mobile phones and hand were 53.9% and 55.3% respectively. The gram negative strains were isolated from mobile phones of 30% and from the hands were 28.6%. The governing bacteria that found from different rooms mobile phones and hand were CoNS and *S. auerus*.

The rate of routine cleaning of HCW's mobile phones was 5.3%, which means 94.7% of the participants never cleaned their mobile phones either daily or weekly. Although the Laboratory technologists and Nurses' phones have higher colony count, there was no significant difference in the rates of specific types of bacterial growth and colony counts isolated on all groups' mobile phones.

About 28.3% of the entire study population had at least one ring on their finger. The mean colony count was higher in ring using staff's phones but there was no significant difference between rate of contamination and colony count ( $p>0.05$ ).

## DISCUSSION

Today's mobile phones are important equipment for physicians, Nurses, Health officers, Midwifery nurses, Anesthesia workers, Laboratory technologists and other health care workers. The transmission of nosocomial pathogens by electronic devices such as personal digital assistants, handheld computers were epidemiologically important and some of them are

drug-resistant pathogens (Bellamy *et al.*, 1998, Isaacs *et al.*, 1998).

Among the electronic device the mobile phone use is highly prevalent among medical staff in Hawassa referral hospital playing a significant role in day-to-day life and contributes positively to their ability to communicate concerning hospital affairs (Ramesh *et al.*, 2008). However; this referred only to technical aspects and gives no consideration of their possible role in transmission of infections (Jeske *et al.*, 2007). Whereas strict attention is paid to changing clothes, removing jewelry, covering hair, undertaking hand hygiene measures, storing personal objects in changing rooms to reduce the transfer of microorganisms from the external clinical environment into the operating environment, most expensive mobile phones often accompany staff into the operating environment, laboratory rooms, ward, ICU as currently no local policy restricting the use of mobile phones in clinically sensitive areas is in place (Ramesh *et al.*, 2008). This lack of attention may be referred to little awareness about potential risks posed by mobile phones microbial contamination and their role as vehicle for transmission of infections (Ramesh *et al.*, 2008).

In our study the rate of mobile phone contamination was 97.4% which is similar to Ulger *et al.* (2009) 94.5%, Elkholy and Ewees 96.5% (Elkholy and Ewees, 2010) and Higher than the report of Auhim (Auhim, 2013). Since no cautionary has been given for cleaning mobile phones to meet hospital standards, the same rates and composition of contamination of mobile phones could be risky when carried outside the hospital environment. Jeske *et al.* (2007) found that the rate of bacterial contamination of HCWs' hands was 95% while that of mobile phone was 90%. Tambekar *et al.* (2008) stated that 95% of mobile phone showed bacterial contamination and among *S. aureus* isolates 83% were meticillin resistant. Snigh

*et al.* (1998) reported that out of 50 mobile phones that were cultured, 98% were positive. On the same context, Table 3: Antibiotic profiles of bacteria

Goldblatt found that, one fifth of the cellular phones used by HCWs harbored pathogenic microorganisms

| S.N <sup>o</sup> | Type of antibiotics | Concentration<br>in µg | Condition of antibiotics |              |            | Remark |
|------------------|---------------------|------------------------|--------------------------|--------------|------------|--------|
|                  |                     |                        | Sensitive                | Intermediate | Resistance |        |
|                  | Ampicillin          | 10 µg                  | 89(28.1%)                | 11(3.5%)     | 217(68.5%) |        |
|                  | Penicillin          | 10 µg                  | 151(47.6%)               | 16(5.0%)     | 150(47.4%) |        |
|                  | Gentamycin          | 10 µg                  | 2544(79.6%)              | 4(1.3%)      | 61(19.1%)  |        |
|                  | Ceftriaxone         | 30 µg                  | 258(81.4%)               | 2(0.6%)      | 57(18.0%)  |        |
|                  | Chloramphenicol     | 30 µg                  | 198(62.4%)               | 5(1.6%)      | 114(36.0%) |        |
|                  | Oxacillin           | 1 µg                   | 197(62.1%)               | 7(2.2%)      | 113(35.7%) |        |
|                  | Vancomycin*         | 30 µg                  | 47(57.3%)                | 2(2.4%)      | 33(40.2%)  |        |
|                  | Ciprofloxacin       | 5 µg                   | 239(75.4%)               | 9(2.8%)      | 69(21.8%)  |        |
|                  | Doxycycline         | 30 µg                  | 247(77.9%)               | 5(1.6%)      | 65(20.5%)  |        |
|                  | Tetracycline        | 30 µg                  | 187(59.0%)               | 18(5.7%)     | 112(15.3%) |        |
|                  | Amoxicillin         | 30 µg                  | 171(53.9%)               | 30(9.5%)     | 116(36.6%) |        |

\*: Vancomycin sensitivity done only for *S. aureus*

and may serve as vectors for health care transmission of microorganisms (Goldblatt, 2007). Also comparing with stationary phone the mobile phone contamination rate was higher than stationary phone and other Keyboards as the report of Butz *et al.* (1993), Singh *et al.* (2010) and Neely *et al.* (1999). Because of this reason Fukada recommended that HCW's should perform hand hygiene before and after touching mobile phone after each procedure and before using any equipment (Fukada, 2008).

In this study the species of bacteria that identified from the phone was quite similar with Ulger *et al.* (2009) and Bhat *et al.* (2011). Similarly bacterial isolates that contaminated mobile phone and hands were similar (Ulger *et al.*, 2009). This is might be due to unclean handling of the phone and hands after each procedure. In line with our study, Brady *et al.* (2007) showed that 89.7% of mobile phones were contaminated by bacteria.

In this study 50.6% of phones grew one bacterial species, 24% grew two different species and 22.8% grew three or more different species and 2.6% swabs of phones did not grow any bacteria species which is similar with the study carried in elsewhere (Elkholy and Ewees, 2010, Badr *et al.*, 2012, Roy *et al.*, 2013).

In our study the Gram-negative strains isolated from mobile phones and from the hands were 62.6% and 63.1% respectively. The most common bacterial species that isolated from mobile phone and hands of the HCW's was *S. aureus*, CoNS, *Streptococcus* spp, *E. coli*, *K. pneumonia*, *Proteus* spp, *Citrobacter* spp, *Shigella* spp and *P. aeruginosa*. Several reports have documented similar results in the contamination of mobile phones among HCW's (Badr *et al.*, 2012, Elkholy and Ewees, 2010, Shahaby *et al.*, 2012, Akinyemi *et al.*, 2009, Karabay *et al.*, 2007, Roy *et al.*, 2013, Bhat *et al.*, 2011, Ulger *et al.*, 2009). However, some strains that reported by these authors were not isolated here in our study due to absence of the reagents and facility.

The rate of *S. aureus* isolated from mobile phone and hands of HCW's were 55.3% and 53.9% respectively. This is higher than the report of Mohamad T (Elkholy and Ewees, 2010). Except Ampicillin the resistance level of all antibiotics was less than 50%. More than 40% of the isolated *S. aureus* were resistant to vancomycin and Oxycilline. Also higher resistances of *S. auerus* were seen to Ampicillin, Penicillin and Ciprofloxacin.

In contrast to Bhat *et al.* (2011) and Tambekar *et al.* (2008) all organisms that identified from both mobile phone and hands of HCW's were multidrug resistant. This is might be due to the carriage of resistance gene against the selected antibiotics. Or the bacteria that found from the surface of the mobile phone might be exposed to the external factors and acquired the resistant. Ampicillin and Penicillin was less effective against the identified bacteria, whereas, Gentamicin, Ceftriaxone, Doxycycline and Ciprofloxacin were most effective (Table 3).

## CONCLUSION AND RECOMMENDATIONS

Our study reveals that mobile phones may get contaminated by bacteria (such as *E. coli*, *P. aeruginosa* and *K. pneumoniae*), which cause hospital infections and may serve as a vehicle for the spread of nosocomial pathogens. The mobile phones may act as a reservoir of microorganisms associated with hospital acquired infection that can be transmitted in to the ICU, laboratory, ward, delivery rooms, operating environment by medical staff as same organism was cultivated from both the mobile phone as well as the hand of the same healthcare workers. Restriction of mobile phone use in clinically sensitive areas, such as operating environment and ICU as a start point, is recommended. Moreover, screening of HCWs' mobile phones inside the hospital should be done while doing environmental screening. Developing active preventive strategies like decontamination of mobile phones with

alcohol containing disinfectant might reduce cross-infection.

**Competing interests:** The authors declare that they have no competing interests.

**Authors' contribution:** DD developed proposal and secured financial support, data collection, laboratory working, analysis of the result, finalizing whole manuscript for publication. DY and ET, read the manuscript and laboratory work. All authors read and approved the final manuscript.

## ACKNOWLEDGMENT

We would like to thank the Research and development of Hawassa University, College of Medicine for providing the financial support and for practical arrangements regarding laboratory work.

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