

Research

## Bacterial Flora of Mobile Phones and Hands of HCWs from a Tertiary Care Hospital

Malhotra S, Saini V, Kaur A, Rawat Y, Bhatia NJK, Chauhan A and Duggal N\*

Department of Microbiology, PGIMER and Dr RMLH, New Delhi, India

### Abstract

#### Background

We aimed to assess the pattern of bacterial flora on mobile phones and hands of healthcare workers in Intensive care unit of our hospital.

#### Methodology

Samples were collected from the hands and mobile phones of 56 healthcare workers of whom 20 were doctors, 29 nurses and 7 other healthcare workers

#### Results

Sixteen healthcare workers showed bacterial isolates like *Staphylococcus aureus* including Methicillin Resistant *Staphylococcus aureus*, Coagulase negative *Staphylococcus*, Aerobic spore bearers etc.) On their mobile phones while hand carriage was found in fifty one staff members.

#### Conclusions

Our study reveals that hands and mobile phones of healthcare workers may get contaminated by bacteria which cause hospital infections, and may serve as a vehicle for the spread of nosocomial pathogens from the mobile phone to the hands and vice versa.

**Keywords:** Mobile phones; Hands; Hospital infections; Healthcare workers

#### Introduction

Mobile phones are the important means of communication worldwide because they are easily accessible, economical and user-friendly. They have become one of the most indispensable accessories of professional and social life. They are widely used by the healthcare workers (HCWs) and non-HCWs equally in every location [1]. The constant handling of mobile phones by users in hospitals (by patients, visitors and HCWs, etc.) makes it an open breeding place for transmission of microorganisms, as well as health care associated infections (HAIs). This is especially because they are in close contact with mouth, nose, ears, hands and various clinical environments [2]. Hospitals in India have a high burden of infections in their intensive care units (ICU) and general wards, many

of which are resistant to antibiotic treatment, according to a report by Global Antibiotic Resistance Partnership (GARP) – India Working Group and Centre for Disease Dynamics, Economics and Policy (CDDEP). A large proportion of these hospital-acquired infections (HAI) are preventable with increased infection control measures [3]. Research on hospital infections in India reveals several concerning trends. In India, the rate of vancomycin-resistant enterococcus (VRE) in ICU, a dangerous hospital infection, is five times the rate in the rest of the world. Rates of Methicillin-resistant *Staphylococcus aureus* (MRSA) are also high, with one study finding over 80 per cent of *S. aureus* samples testing positive for resistance to Methicillin and closely related antibiotics [3]. Hospital acquired infections are generally multiple antibiotic resistant and are difficult to treat. They lead to longer hospital stays, increased treatment costs, and in some cases, death. The GARP research estimates that of the approximately 190,000 neonatal deaths in India each year due to sepsis—a bacterial infection that overwhelms the blood stream—over 30 per cent are attributable to antibiotic resistance. Antibiotic resistant hospital infections can be especially deadly because antibiotics are used intensely in hospitals compared with the community, and frequent use drives the development of highly resistant bacteria. Organisms causing hospital infections in India are similar to those around the world, with *S. aureus* and *P. aeruginosa* among the most common disease-causing pathogens. A prospective study of 71 burn patients at Post Graduate Institute of Medical

**\*Corresponding Author:** Malhotra S, Department of Microbiology, PGIMER and Dr RMLH, New Delhi, India

**Sub Date:** March 5<sup>th</sup> 2018, **Acc Date:** March 29<sup>th</sup> 2018, **Pub Date:** March 30<sup>th</sup> 2018.

**Citation:** Malhotra S, Saini V, Kaur A, Rawat Y, Bhatia NJK, Chauhan A and Duggal N (2018) Bacterial Flora of Mobile Phones and Hands of HCWs from a Tertiary Care Hospital. BAOJ Microbio 4: 032.

**Copyright:** © 2018 Malhotra S, et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Education and Research (PGIMER) in Chandigarh [3] found that up to 59 patients (83 per cent) had hospital-acquired infections: 35 per cent of pathogens isolated from wounds and blood were *S. aureus*, 24 per cent were *P. aeruginosa*, and 16 per cent were beta-haemolytic *streptococci* [3]. Another six-month study conducted in 2001 of the intensive care units (ICUs) at All India Institute of Medical Sciences (AIIMS) in New Delhi, found that 140 of 1,253 patients (11 per cent) had 152 hospital-acquired infections, where *P. aeruginosa* made up 21 per cent of isolates, 23 per cent were *S. aureus*, 16 per cent *Klebsiella spp.*, 15 per cent *Acinetobacter baumannii* and 8 per cent *Escherichia coli*. Further, a study of 493 patients in a tertiary teaching hospital in Goa also found that 103 people (21 per cent) developed hospital acquired infections [3]. Mobile phones are often touched during activities related to health care like- examining the patients, providing nursing care, processing the samples, etc. Hence mobile phones are likely to get contaminated by various micro-organisms, some of which could very well be pathogenic in nature like *Staphylococcus aureus* (*S.aureus*) including MRSA, *Escherichia coli*, *Pseudomonas spp.*, *Acinetobacter spp.*, *Candida* etc. Hence mobile phones can be potential source of HAI as hands will get colonised with the flora on mobile phones which leads to HAIs [4]. HAIs affect more than 25 percent of admitted patients in developing countries. It is estimated that one third of these infections could be prevented by adhering to standard infection control guidelines [4]. Multidrug resistant (MDR) bacteria like *methicillin resistant Staphylococcus aureus* (MRSA), vancomycin resistant enterococci (VRE) and extended spectrum  $\beta$ - lactamase (ESBL) are commonly implicated in HAIs and can be challenging to eliminate [5]. MRSA is a known pathogen causing HAI which are difficult to treat due to multidrug resistance and its nasal carriage varies from 5-15%. The nasal carriage of MRSA among HCWs has indicated the chances of transmission of the organism to patients during patient-care [6]. Screening of mobile phones has been carried out in several studies [7,8]. Most of the studies have shown bacterial contamination of mobile phones of health care personnel. However, there is lack of literature regarding the correlation between the bacterial contamination of mobile phones and hand carriage of these pathogens. So the current study was performed to establish correlation between the bacterial flora on mobile phones and hands of HCP.

## Materials and Methods

This study was carried out over a period of 2 months (March 2017 to April 2017) by sampling the mobile phones and hands of 56 health care

personnel categorized into doctors (n=20), nurses (n=29) and other HCW (n=7) working in Trauma ICU of PGIMER and DR.RMLH, New Delhi. Subjects with fever, running nose, sore throat, infected open wounds or on antibiotics were excluded from the study. After taking informed consent from the health care workers, sterile swabs moistened with sterile saline were used to swab various surfaces of the mobile phones and hand culture was performed by the hand imprint method [9]. The swabs from mobiles were transported in BHI broth to the microbiology laboratory (with a maximum delay of 1 hour). These were then plated onto 5% Sheep Blood Agar and MacConkey's agar. BHI broth was incubated at 37°C aerobically overnight and sub cultured if turbid. Blood agar plates for hand culture were also incubated at 37°C aerobically overnight for bacterial growth. Identification of various bacterial isolates was carried out as per standard identification techniques based on morphology, biochemical reactions [10]. All the bacterial isolates were tested for their antimicrobial susceptibility patterns (AST patterns) by the method of Kirby Bauer disc diffusion as per CLSI guidelines [11]. The antibiotics used were Cefuroxime (30mcg), Ciprofloxacin (5mcg), Erythromycin (5mcg), tetracycline (30mcg), cotrimoxazole (25mcg), vancomycin (30mcg) which were supplied by Himedia. In addition, cefoxitin (30mcg) discs were used to look for methicillin resistance amongst the *S.aureus* isolates followed by confirmation using e test and agar screen method [11] as per the Clinical and Laboratory Standards Institute (CLSI) guidelines which recommends the cefoxitin disk screen test (zone size more than equal to 22mm/25mm for *S.aureus* and Coagulase negative *S.aureus* resp. or a plate containing 6  $\mu$ g/ml of oxacillin in Mueller-Hinton agar supplemented with 4% NaCl as alternative methods of testing for MRSA.

## Observation and Results

A total of 56 HCW were screened for presence of bacteria on hands and mobile phones. Amongst these, sixteen HCWs showed bacteria on their mobile phones (5 were positive for *Staphylococcus aureus*, 4 for Coagulase negative *Staphylococcus* and 7 for others i.e. Aerobic Spore Bearers (ASB), *Micrococcus* etc. Fifty one HCWs were positive for hand carriage of various bacterial species (24 were *Staphylococcus aureus*, 19 were Coagulase negative *staphylococcus* and 10 for others i.e. ASB, *micrococcus* (Table 1). Out of 24 *S.aureus*, 21 were MSSA (methicillin sensitive *Staphylococcus aureus*) and 3 were MRSA (methicillin resistant *Staphylococcus aureus*) (Table 2).

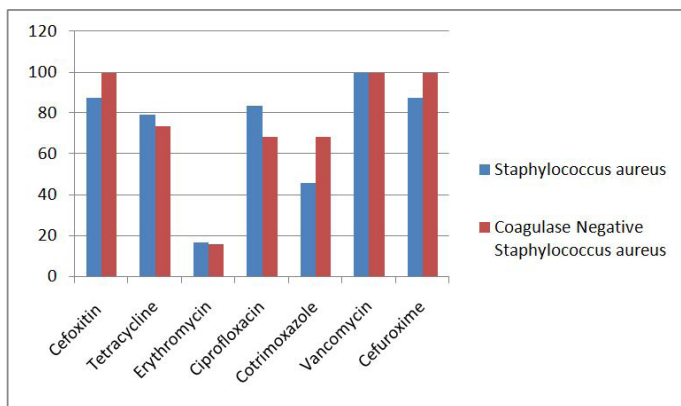
**Table 1:** Distribution of bacterial flora amongst various categories of HCWs.

	Total number (including <i>S.aureus</i> , CONS, diptheroids, ASB micrococcus.)	Doctor	Nursing staff	Other HCW
Total HCW screened	56	20	29	7
Positive for hand carriage	51(91.07%)	20	24	7
Positive for mobile phones	16(28.57%)	4	7	5
Positive for both with same organism	4(7.14%)	0	3	1

**Table 2:** Isolation rate of MRSA from hands of different health care personnel

	Methicillin Resistant	Methicillin Sensitive	% MRSA
Nurses	3	11	27.27%
Doctors	0	6	0%
Other HCW	0	4	0%
Total	3	21	12.5%

All the *S.aureus* isolates from mobile phones were sensitive to cefoxitin followed by Cefuroxime (100%), tetracycline (50%), ciprofloxacin (100%), vancomycin (100%), erythromycin (25%) and cotrimoxazole (50%). Sensitivity pattern for CONS was cefoxitin (100%), Cefuroxime (100%), tetracycline (40%), vancomycin (100%), erythromycin (20%), ciprofloxacin (40%) and cotrimoxazole (20%). Sensitivity pattern of *S.aureus* from hand carriage was-cefoxitin (87.50%), Cefuroxime (87.50%), tetracycline (79.16%), ciprofloxacin (83.33%), vancomycin (100%), erythromycin (16.66%) and cotrimoxazole (45.83%). Sensitivity pattern for CONS was- cefoxitin (100%), Cefuroxime (100%), tetracycline (73.68%), vancomycin (100%), erythromycin (15.78%), ciprofloxacin (68.42%) and cotrimoxazole (68.42%) sensitive (figure 1).



**Figure 1:** Spectrum of Antimicrobial Susceptibility Pattern from Hands of HCWs

Amongst various categories of HCWs screened, maximum isolation of bacterial flora on hand was found in nursing staff followed by doctors and others (Table 1). Four HCWs were found to harbour same organism on hands as well as mobile phones (i.e. *S.aureus*)

## Discussion

Mobile phones are very frequently used in ICU by healthcare workers as they are an effective means of communication. However, less attention is

paid to standard infection control practices while using mobile phones by healthcare workers. Several studies have shown how mobile phones belonging to healthcare workers constitute a device on which various microorganisms linked to nosocomial infections can congregate [12,13]. In our study, *S.aureus* (31.25%) was the predominant organism isolated in mobile phones (which is the predominant gram positive nosocomial infection in our hospital) whereas isolation rate of CONS on mobile phones was 25% which was lower as compared to other studies (a study conducted in Nigeria shows isolation rate of *S.aureus* and CONS is 30.64% and 42.74% and a study conducted in Italy shows isolation rate of 64.1% and 33.3% respectively) [14,15]. In contrast to this, the hand carriage of *S.aureus* was found to be 47.05% amongst various categories of HCWs with 12.5% isolates resistant to cefoxitin (MRSA). In our study, CONS was isolated in 37.25% HCWs which was comparable to other studies (a study conducted in Italy isolation rate of *S.aureus* and CONS was 67.4% and 32.5% and study conducted in USA, hand carriage of *S.aureus* was found in 24.9%) [16,17]. This is due to a dedicated HICC (Hospital Infection Control Committee) which comprises of 4-5 ICN (Infection Control Nurses) who regularly visit the ICU to ensure strict compliance to safe infection control practices in the whole hospital including ICU. This team of ICN promotes restricted use of mobile phones inside ICU and strict compliance to hand hygiene. Our results are consistent with international literature [16-18]. Demonstrating that mobile phones used routinely by healthcare workers represent an important vehicle of contamination since potential pathogens capable of causing nosocomial infections pass from the mobile phone to the hands and vice versa. It is therefore essential to adopt precautionary measures to prevent hospital infections and to avoid the risk of cross contamination. These measures, i.e. careful hand hygiene while performing all the five moments using soap solution/hand rub (60-80% alcohol based) should be adopted by healthcare workers after the use of the mobile phone [19-21]. However, re-contamination of hands from mobile phones is very rapid for the frequent use of these devices by HCW for many activities, i.e. while taking pulse, blood pressure etc. [22] never the less, it is more difficult to sanitize mobile phones as they are sensitive to liquids and high temperatures and therefore cannot be disinfected as frequently as hands. Hence, the use of mobile covers would be useful as this would allow the phones to be disinfected using chemical products without damaging the phone itself [18]. As an important precaution, healthcare workers should be advised to limit their use of mobile phones in high risk areas and in wards [23, 6, 16, 18]. The same precautions should also be adopted for mobile phones belonging to inpatients [24]. In our study, 7.14% of HCWs were found positive for same pathogenic organism from both mobile phones and hands which was a significant finding demonstrating that these potential pathogens can transmit from mobile phone of HCWs to patients. Therefore there is a need to generate awareness about spread of harmful pathogens via mobile phones and hands. As mobile phones have become indispensable devices today,

restrictions on their use is not a practical solution. Thus increasing the level of awareness among the health care personnel would lead to better adherence to hand hygiene as well as restricted use of the mobile phones in critical areas like ICU.

### Limitations and Study

There is always a resistance at the end of healthcare workers to accept that their hands/mobile phones are potential vehicles for transmission of HAI. Also Molecular typing for MRSA is not available in our institute.

### References

1. Rana R, Joshi S, Lakhani S, Kaur M, Patel P (2013) Cell phones – homes for microbes. *Int J Biol Med Res* 4: 3403-3406.
2. Tagoe DN, Gyande VK, Ansah EO (2011) Bacterial Contamination of Mobile Phones When Your Mobile Phone Could Transmit More Than Just a Call. *Webmed Central Microbiology* 2: 2294.
3. Indian medical times (2011) Hospital-acquired infections high in India: Study.
4. Tambe NN, Pai C (2012) A study of microbial flora and MRSA harboured by mobile phones of health care personnel. *International Journal of Recent Trends in Science and Technology* 4: 14-8.
5. Selim HS, Abaza AF (2015) Microbial contamination of mobile phones in a health care setting in Alexandria, Egypt. *GMS hygiene and infection control* 10.
6. Khanal R, Sah P, Lamichhane P, Lamsal A, Upadhaya S, et al. (2015) Nasal carriage of methicillin resistant *Staphylococcus aureus* among health care workers at a tertiary care hospital in Western Nepal. *Antimicrob Resist Infect Control* 9: 4-39.
7. Brady RR, Wasson A, Sterling I, McAllister C, Damani NN (2006) Is your phone bugged? The incidence of bacteria known to cause nosocomial infection on health care workers' mobile phones. *J Hosp Infect* 62: 123-125.
8. Usha S, Jayalakshmi J, Appalaraju B (2007) Cell phones as reservoir of nosocomial pathogens Abstract no: OA -10 IX – National Conference of Hospital Society of India, Chandigarh, India 16th February.
9. Leyden JJ, McGinley KJ, Kaminer MS, Bakel J, Nishijima S, et al. (1991) Computerized image analysis of full-hand touch plates: a method for quantification of surface bacteria on hands and the effect of antimicrobial agents. *J Hosp Infect* 18: 13-22.
10. Collee JG, Marmion BP, Fraser AG, Simmons A, Mackie, et al. (1996) *Practical Medical Microbiology*. Churchill Living stone 131-150.
11. CLSI (2013) Performance standards for antimicrobial susceptibility testing. CLSI approved standard M100-S23. Clinical and Laboratory Standards Institute, Wayne, PA.
12. Hendley JO, Wenzel RP, Gwaltney JMJ (1997) Transmission of rhinovirus colds by self-inoculation. *N Engl J Med* 288: 1361-664.
13. Noble J (2001) *Textbook of primary care medicine*. 3rd ed. St Louis Mosby 8: 82-95.
14. Akinyemi KO, Atapu AD, Adetona OO, Coker AO (2009) The potential role of mobile phones in the spread of bacterial infections. *The Journal of Infection in Developing Countries* 3: 628-32.
15. La Fauci V, Grillo OC, Facciola A, Merlina V, Squeri R (2014) The Possible Role of Mobile Phones in Spreading Microorganisms in Hospitals. *J Microb Biochem Technol* 6: 334-6.
16. David MZ, Siegel JD, Henderson J, Leos G, Lo K, et al. (2014) Hand and nasal carriage of discordant *Staphylococcus aureus* isolates among urban jail detainees. *Journal of clinical microbiology* 52: 3422-5.
17. Ulger F, Esen S, Dilek A, Yanik K, Gunaydin M, et al. (2009) Are we aware how contaminated our mobile phones with nosocomial pathogens? *Ann Clin Microbiol Antimicrob* 8: 7.
18. Kramer A, Schwebke I, Kampf G (2006) How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. *BMC Infect Dis* 6: 130.
19. Tekerekoğlu MS, Duman Y, Serindağ A, Cuğlan SS, Kaysadu H, et al. (2011) Do mobile phones of patients, companions and visitors carry multidrug-resistant hospital pathogens? *Am J Infect Control* 39: 379-381.
20. Brady RR, Hunt AC, Visvanathan A, Rodrigues MA, Graham C, et al. (2011) Mobile phone technology and hospitalized patients: a cross-sectional surveillance study of bacterial colonization, and patient opinions and behaviours. *Clin Microbiol Infect* 17: 830-835.
21. Beer D, Vandermeer B, Brosnikoff C, Shokoples S, Rennie R, et al. (2006) Bacterial contamination of health care workers' pagers and the efficacy of various disinfecting agents. *Pediatr Infect Dis J* 25: 1074-1075.
22. Johnson PD, Martin R, Burrell LJ, Grabsch EA, Kirsas SW, et al. (2005) Efficacy of an alcohol/chlorhexidine hand hygiene program in a hospital with high rates of nosocomial methicillin-resistant *Staphylococcus aureus* (MRSA) infection. *Med J Aust* 183: 509-514.
23. Morris TC, Moore LS, Shaunak S (2012) Doctors taking a pulse using their mobile phone can spread MRSA. *BMJ* 344: 412.
24. Brady RR, Verran J, Damani NN, Gibb AP (2009) Review of mobile communication devices as potential reservoirs of nosocomial pathogens. *J Hosp Infect* 71: 295-300.