Bacteriological Screening of Hands and Mobile Phones of Healthcare Workers and Its Management

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Research Article

Abstract: **Introduction:** The hands and cell phones can harbor various potential pathogens and become an exogenous source of nosocomial infection among hospitalized members. The present study highlights the need of continuous screening of pathogens carried through hands and cell phones and also its proper management. **Aims and Objectives:** To determine nosocomial infections carried through hands and cell phones of healthcare workers and its management through surface sterilization. **Material and Methods:** Fifty samples collected from both hands and cell phones of healthcare workers, working in various departments at government hospital, Mandya were subjected to bacteriological analysis. Using sterile cotton tipped applicator moistened with nutrient broth samples were collected from both hands and front, back and the sides of the cell phones. Collected samples were cultured and the resulting isolates were identified. The above procedure was repeated after decontamination of cell phones using 90% alcohol. **Results:** Out of 50 nursing staff screened, hands swab showed 22% *of Staphylococcus aureus*, 3% of *Streptococcus* spp. and 3% of *Enterobacter aerogenes* where as on mobile phones swab showed 52% of *Staphylococcus aureus,* 34% of *Streptococcus* spp. and 4% of *Bacillus* spp. After decontamination with 90% alcohol only 4 mobile phones showed growth of bacteria which are nonhaemolytic, thus proving the efficacy of decontamination to be nearly 83%. The bacterial isolates were further subjected to antibiotic sensitivity test by disk diffusion as well as well diffusion methods on Muller Hinton agar medium. It is quite interesting to observe that different strains of *Staphylococcus aureus* recorded varied response to the same antibiotic used in the study. **Conclusions:** This is an important study carried out to report the varied response of different strains of *Staphylococcus aureus* against already available/used antibiotics and need of regular checking of hands and handset as a source of inoculum of potential pathogenic bacteria. The difference in genetic set up among the strains can be worked out by further molecular studies.
Keywords: Carriers, Hands and cell phones, Healthcare workers.

Introduction

Health Care Associated Infection (HCAI) refers to infection, which is usually acquired 48 hour or more, after admission to the hospital or after contact with a healthcare facility, such as a day care unit or a nursing home, etc., HCAI can be caused by both antibiotic-susceptible and antibiotic-resistant bacteria, which can arise from the patient's own flora (endogenous) or can be acquired from other patients, the hands of healthcare workers or from the healthcare environment (exogenous) and cell phones of healthcare workers.[1] Transmission of infection in a hospital requires at least three elements; a source of infecting bacteria, a susceptible host and a means of transmission. The hands and cell phones can harbor various potential pathogens and become an exogenous source of nosocomial infection among hospitalized members. It was demonstrated by Semmelweis in 1861[2] itself that bacteria were transmitted to the patients by contaminated hands of healthcare personnel. Even though the medical science has achieved several advances in modern medicine, nosocomical infection is a persisting problem with high morbidity and mortality and in this connection there are several reports to prove that hands of healthcare personnel may play an important role in hospital acquired infection (HAIs). [3,4,5] One the other hand, the use of mobile phones has been increased drastically among the healthcare personnel who are also serving as a medium to transfer pathogenic microbes from them to immunosuppressed hopitalised patients.[6,7,8,9,10,11] Another important aspect is 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 and hence the pathogens will have free access from one ward to another through mobile phones.[3] Several pathogenic bacteria including viruses and the nosocomial pathogenic fungi *Candida* can survive for a few months on inanimate objects and thus be transmitted to susceptible patients. The hospital personnel tend to have higher colonization of Methicillin-Resistant *Staphylococcus aureus* (MRSA) than the general population. The personnel with MRSA colonization are the sources of dissemination of the organisms, both in the hospital and the community.[12,13] Some studies have evaluated *Staphylococcus aureus* in contamination of

various items such as stethoscopes,[14] pen,[15] contamination of computer devices,[16] cell phones and television sets[17] and anaesthetists hands, personal mobile phones and wrist watches used during theatre sessions.[18] However the study on bacteriological screening of HCWs from Mandya district, Karnataka, for pathogenic bacteria and also management of such bacteria was not reported by earlier workers and hence the present study.

Material and Methods

Sample collection

Using sterile cotton tipped applicators a total of 50 swabs from hands and handset of nursing staffs of Mandya Government Hospital, Mandya was obtained. The samples were collected aseptically using swabs moistened with sterile saline. Samples were collected from both hands (taken after at least 30 min of the last hand wash) and handsets of HCWs. By rotating the swabs over the mouthpiece, earpiece, keypad and external cover of the mobile phones. The swabs were inserted aseptically into sterilized test-tubes plugged the mouth with cotton and transferred to the laboratory.

Identification and characterization

Identification and conformation of the isolated organisms were done by microscopic observation along with cultural characteristics and biochemical tests. Identification of *Staphylococcus aureus* and other pathogenic bacteria isolates was done based on growth on sheep blood agar, fermentation on mannitol salt agar and its colony morphology on nutrient agar medium (Hi media, India). Other tests performed include Gram's staining along with biochemical tests such as catalase, gelatin hydrolysis and starch hydrolysis slide and tube coagulase, utilisation of OF-glucose and mannitol tests. Staphylococci were further identified based on biochemical tests such as lactose fermentation, motility, indole production, sugar fermentation and H_2S production, urease production, citrate utilization and MR-VP test for the nature of fermentation. Non-fermenters were further identified using catalase and oxidase tests, ability to grow on MacConkey agar and growth at 42 °C and biochemical tests like OF-dextrose utilization, nitrate reduction and gelatin hydrolysis.

Antibiotic Sensitivity test

All confirmed *Staphylococcus aureus* isolates were subsequently tested for antibiotic sensitivity test. Sensitivity of isolates to antibiotics was determined on Mueller-Hinton Agar (MHA) media by both disk diffusion (Streptomycin, Penicillin, Erythromycin, Ciprofloxacin and Amoxicillin) (Hi media, India) and well/ cup diffusion method (different antibiotics viz., Ofloxacin, Amoxicillin, Ciprofloxacin and Levofloxacin). This was selected based on the availability of antibiotic disc. Antibacterial activity of antibiotics was determined by cup diffusion method on MHA[19] (Anon, 1996). Cups

were made in MHA plate using sterile cork borer (5 mm) and inoculum containing 10^6 CFU/mL of bacteria were spread on the solid plates with a sterile swab moistened with the bacterial suspension. Then 50 μL each of antibiotics were placed in the cups made in inoculated plates. The treatments also included 50 μL of sterilized distilled water which served as control. The plates were incubated for 24 hrs. at 37 °C and zone of inhibition if any around the wells was measured in mm (millimeter). For each treatment four replicates were maintained. The data was subjected to statistical analysis of variance (ANOVA). Other bacteria isolated in the present study were also tested for antibiotic sensitivity as explained earlier.

Surface sterilization of cellphones of HCWs

Surface of the cell phones were wiped using 90% alcohol, allowed to air dry. After 5 min using sterile cotton tipped applicator, samples were collected and transferred to the laboratory for bacterial examination as mentioned above.

Results

After suitable period of incubation, the obtained bacterial colonies were identified by the analysis of conventional microbiological methods and were enumerated. The number of colonies developed in each of the culture plates is counted using colony counter. Out of 50 nursing staffs, 22 were male and 28 were females. The percentage frequency of isolated different bacteria from hands swab and cell phones swab shows in the figure 1 and 2. Before decontamination, 23 cell phones showed different bacterial growth and haemolysis on blood agar media whereas after decontamination with 90% alcohol only 4 cell phones showed growth and the culture showed no haemolysis, thus proving efficacy of decontamination to be nearly 83%. It is quite interesting to observe that varied response of different strains of *Staphylococcus aureus* (Table1, 4, 5) and other isolated bacteria viz., *Enterobater aerogenes* (Table 3), *Bacillus subtilis* (Table 2) against same antibiotics used in the study. This is an important report to state the varied response of different strains of *Staphylococcus aureus* against already available/ used antibiotics. Gram positive cocci in clusters were observed. Of the 50 participants, from 6 wards 22 were male and 28 were females. Out of 50 nursing staff screened, hands swab shows 22% of *Staphylococcus aureus*, 3% of *Streptococcus* spp., and 3% of *Enterobacter aerogenes* where as on cell phones swab 52% of *Staphylococcus aureus,* 34% of *Streptococcus* spp., and 4% of *Bacillus* spp. was observed (Figure 1, 2). In the present study, in all age group of HCWs *Staphylococcus aureus, Enterobacter aerogenes* and *Bacillus subtilis* were isolated and identified by microscopic and biochemical tests. The screened isolates

which were collected from the hand and cell phones swab proves the presence of the *Staphylococcus aureus*, by microscopic method shows Gram +ve, cluster of cocci and was confirmed by biochemical tests and found positive for catalase test, mannitol fermentation by the production of acid which turns the media color from pink to yellow and also hemolysis on blood agar media where as *Streptococcal* spp. were chains of cocci under microscopic observation and is catalase negative.

Discussion

The present work was carried out in the SITAR Institute, Mandya, to screen and to detect the pathogenic bacteria rate mainly the existence of the *Staphylococcal* carriage state among the nursing staff from their cell phones and hand swab, as they were potential carriers of pathogens in the hospital environment. The isolated *Enterobacter aerogenes* were confirmed by citrate utilization test which was found positive for the strain and also *Bacillus subtilis* was confirmed by rod shaped bacilli under microscope and positive gelatin hydrolysis test confirmed the organism. The isolates were further subjected to antibiotic sensitivity test by disk diffusion as well as well diffusion methods using MHA medium. It is quite interesting to observe that varied response of different strains of *Staphylococcus aureus* against same antibiotics used in the study. This is an important report to state the varied response of different strains of *Staphylococcus aureus* against already available/ used antibiotics. The difference in genetic set up among the strains can be worked out by further molecular studies. In the present study, about 90 % of alcohol is used as an effective disinfectant for the surface sterilization of the cell phones, this showed reduction in the load of the pathogenic bacteria to the extent of 83%, compared to the samples tested before sterilization and hence proves as an effective disinfectant. To manage HCAI, Patil and Pawar[20] suggested that active preventive strategies like routine decontamination of mobile phones with alcohol containing disinfectants might reduce cross infection and the present tried 90% alcohol as a disinfectant and proved highly successful to disinfect the mobile phones effectively. 90% of alcohol was selected in the study keeping in view of amount water which may spoil the functioning of the mobile phones. The profile of microorganisms isolated from mobile phones in our study is similar to previous reports. Previous studies on bacterial contamination of mobile phones revealed the presence of Methicillin-resistant *Staphylococcus aureus*, Methicillin-sensitive *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Acinetobacter*, *Enterococcus faecalis* and *Pseudomonas aeruginosa*,[21] 150 health care workers were screened for *Staphylococcus aureus* by Goyal[22] and they observed that 50% are carrying MRSA

on Hands. The antibiotic sensitivity pattern of the isolates was also studied by them, which shows 100% sensitivity to vancomycin and 30% MRSA were resistant to other antibiotics. Braddy et al.,[8] and Karabay et al.,[9] reported the isolation of Gram negative bacilli from the mobile phones. Khivasara et al.,[7] reported 40% contamination of mobile phones by *Staphylococcus* and MRSA from HCWs working in a Mangalore Hospital. *Staphylococcus saprophyticus*, *Staphylococcus aureus*, *Pseudomonas aeruginosa and Serrattia* spp. were also transferred in greater numbers than *Escherichia coli* from contaminated fabric to clean fabric after hand contact.[23] Organisms are transferred to various types of surfaces in much larger numbers (that is, > 104) from wet hands than from hands that are thoroughly dried.[24] It was also reported by Oie *et al.*,[25] that door handles in 27.0% of 196 rooms were contaminated by MRSA. It is interesting to note that presence of pathogenic organisms such as *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Acinetobacter* spp., *Klebsiella pneumoniae*, and *E. coli* are even reported in the mobile phones of corporate users.[26]

The results suggest that cross contamination of bacteria between the hands of healthcare personnel and their mobile phones is possible. The mobile phone could act as a reservoir of infection which may facilitate patient to patient transmission of bacteria in a hospital environment [19]. *Staphylococcus aureus* is a pathogen of greater concern because of its virulence,[27] its ability to cause a diverse array of life threatening infections, and its capacity to adapt to different environment conditions.[28,29] Along with this *Ps. aeruginosa* had been reported in the United States by the Centre for Disease Control and Prevention to be the most isolated nosocomial pathogen accounting for 10.1% of all hospital acquired infections, and has been implicated in gastrointestinal infection, primarily in immunocompromised individuals,[30] but in the present study *Pseudomonas* sp. were not observed in all the samples. It has been estimated that one third of all nosocomial infections may be preventable and are frequently caused by organisms acquired within the hospital environment.[31] The present study proves the need of hand washing after each use of mobile phones strictly and strongly recommends the use of 90% alcohol to disinfect the mobile phones. It is interesting to note that there are no rules to regulate the use of mobile phones by medical staff in India, therefore there must be regular screening to contain the infectious diseases acquired in hospitals. This study helped the healthcare personnel of the hospitals where work was conducted to take care of infections transferred unknowingly from them to patients. Routine screening at hospital admission identifies about one-half of the carriers, with the other one-half being

identified by positive clinical cultures or a history of MRSA.[32,33,34] Resident flora of the body normally does not cause the infection unless the person is immunocompromised, but the transient flora tends to be more pathogenic and is responsible for nosocomial infections. These transient floras may be picked up by the hands of HCW when they touch the patients or contaminated mobile phones and other surgical instruments. So the frequent hand washing and decontamination of mobile phones could remove this transient flora. There are reports to use 70 % isopropyl alcohol as an effective disinfectant [8] and other study reports that restricted use of mobile phones during working hours along with proper hand hygiene practices enable mobile phones to remain free of contamination.[10] Mobile phones are ideal sites for pathogenic microbes as they are kept warm and snug in pockets and handbags Also, there are no guidelines for the care, cleaning and restriction of mobile phones in health care settings. Simple measures such as increasing hand hygiene and regular decontamination of mobile phones with alcohol disinfectant wipes may reduce the risk of cross contamination caused by these devices.[35]

Conclusions

The present study revealed the detection and prevalence of cell phones and hand carriage of *Staphylococcus aureus* strains among the nursing staffs who worked in a high risk areas. *Staphylococcus aureus* is one of the most frequently isolated bacteria in hospital infections. In present study out of 50 samples, it was isolated in 10 samples and is a cause of concern. This represents an additional route for cross-transmission of *Staphylococcus aureus.* In conclusion, the possible methods of decontamination of mobile phones using 90% alcohol can efficiently eliminate or can decrease the number of *Staphylococcus aureus* strains. Restrictions on the use of personnel mobile phones by healthcare workers in hospitals is not a practical solution, they should practice preliminary precautions such as hand washing after each use of the cell phone and regular its surface sterilization.

Acknowledgement

References

1. Smyth ETM, McIlvenny G, Enstone JE, Emmerson AM, Humphreys H, Fitzpatrick F, Davies E, Newcombe RG, Spencer RC: Four country healthcare associated infection prevalence survey 2006: overview of the results: Journal of Hospital Infection. 2008; 69(3):230-248.
2. Semmelweis IP, Die Aetilogie, der Begriff und die Prophylaxis des Kindbettfiebers. Budapest: C.A. Hartleben's Verlags-Expedition; 1861.
3. Ulger F, Esen S, Dilek A, Yanik K, Gunaydin M, Hakan L: Are we aware how contaminated our mobile phones with nosocomial pathogens?: Annals of Clinical Microbiology and Antimicrobials. 2009; 8:7-11.
4. Yusha'u M, Bello M, Sule H: Isolation of bacteria and fungi from personal and public mobile cellphones: A case study of Bayero University, Kano (Old Campus): International Journal of Biomedical and Health Sciences. 2010; 6(1):97-102.
5. Popovska K, Zdravkovska M, Blazevska B, Icev K, Eftimovski G: Implementation of proper hand hygiene among microbiological laboratory workers respectively to WHO guidelines: Macedonian Journal of Medical Sciences. 2012; 5(2):147-151.
6. Meltzer B, Nosocomial infections: Docs' cell phones may spread hospital infections: Outpatients Surgery Magazine. 2003; 11:1-4.
7. Khivsara A, Sushma T, Dhanshree B: Typing of *Staphylococcus aureus* from mobile phones and clinical samples: Current Science. 2006; 90(7):910-912.
8. Brady RRW, Wasson A, Stirling I, McAllister, Daman NN: Is your phone bugged? The incidence of bacteria known to cause hospital acquired infection on healthcare mobile phones: Journal of Hospital Infection. 2006; 62:123-125.
9. Karabay O, Kocoglu E, Tahtaci M: The role of mobile phone in the spread of bacteria associated with nosocomial infections: The Journal of Infection in Developing Countries. 2007; 1:72-73.
10. Goldblatt JG, Krief I, Haller TD, Milloul V, Sixsmith DM, Srugo I, Potasman I: Use of Cellular Telephones and Transmission of Pathogens by Medical Staff in New York and Israel: Infect Control and Hospital Epidemiolology. 2007; 28:500-503.
11. Akinyemi KO, Atapu AD, Adetona OO, Coker AO: The potential role of mobile phones in the spread of bacterial infections: The Journal of Infection in Developing Countries. 2009; 3(8):628-632.
12. Tolan RW: (2007). *Staphylococcus aureus* infection. Available at http:www,emedicine.com/2704.htm.
13. Malini J, Harle SA, Padmavathy M, Umapathy BL, Navaneeth BV, Keerthi MJ, Girish MS: Methicillin resistant *Staphylococcus aureus* carriage among the health care workers in a tertiary care hospital: Journal of Clinical and Diagnostic Research. 2012: 6(5):791-793.
14. Cohen HA, Matalon J: Stethoscope and otoscope - A potential vector of infection: Family Practice 1997; 14: 446-448.
15. Patil P, Hulke S, Thakre A, Gaikwad M: Pen of health care workers as vector of infection: Online Journal of Health and Allied Sciences. 2010; 9(3):15-17.
16. Devine J, Cooke RPD, Wright EP: Is methicillin-resistant *Staphylococcus aureus* (MRSA) contamination of ward-based computer terminals a surrogate marker for nosocomial MRSA transmission and handwashing compliance?: Journal of Hospital Infection. 2001; 48(1):72-75.
17. Stacey A, Burden P, Croton C, Jone E: Contamination of television sets by *Staphylococcus aureus*. Journal of Hospital Infection 1998; 39:243- 244.
18. Gunasekara TDCP, Kudavidanage BP, Peelawattage MK, Meedin F, Guruge LD, Nanayakkara G, Nanayakkara M, Fernando SSN: Bacterial contamination of anaesthetists hands,

personal mobile phones and wrist watches used during theatre sessions: Sri Lankan Journal of Anaesthesiology 2009; 17(1):11–15.

19. Anon. 1996. The Indian Pharmacopoeia. 3rd edition. Government of India, New Delhi. Ministry of Health and family welfare.

20. Patil PD, Pawar SA: Nosocomials hazards of doctors' mobile phones: Journal of Theoretical and Experimental Biology 2012; 8:115-121.

21. Bhat SS, Hegde SK, Salian S: Potential of mobile phones to serve as a reservoir in Spread of Nosocomial Pathogens: Online Journal of Health and Allied Sciences. 2011; 10(2):14-16.

22. Goyal R, Das S, Mathur M: Colonization of MRSA among health care workers in a tertiary care hospital of Delhi: Indian Journal of Medical Science. 2002; 56:321-4.

23. MacKintosh CA, Hoffman PN: An extended model for transfer of microorganisms via the hands at laundry. Differences between organisms and the effect of alcohol disinfection: Journal of Hygiene. 1984. 92(3): 345-355.

24. Patrick D, Findon R, Miller TE: Residual moisture determines the level of touch-contact associated bacterial transfer following hand washing: Epidemiology and Infection. 1997; 119:319-325.

25. Oie S, Hosokawa I, Kamiya A: Contamination of room door handles of Methicillin-Sensitive/ Methicillin-Resistant *Staphylococcus aureus*: Journal Hospital Infection. 2002; 51:140-143.

26. Srikanth P, Rajaram E., Sudharsanam S., Lakshmanan A., Umamaheswari SSM, Kalyani J: The mobile phone in a tropical setting – emerging threat for infection control: Sri Ramachandra Journal of Medicine. 2009; 2(2):18-20.

27. Chamber HF: Community-associated MRSA-resistance and virulence converge: Journal of Medicine. 2005; 352: 1485-1487.

28. Lowy FD: *Staphylococcus aureus* infections: New England Journal of Medicine. 1998; 339:520-532.

29. Lowy FD: Antimicrobial resistance: the example of *Staphylococcus aureus*: Journal Clinical Investigation. 2003; 111:1265-2127.

30. Todar M: *Pseudomonas aeruginosa* in Web Review of Todar's Online Textbook of Bacteriology "The Good, the Bad, and the Deadly" Science Magazine 2004; 304: 1-12.

31. Hughe JM: Study on the efficacy of nosocomial infection control: Infection Control Epidemiology. 1988; 34:553-561.

32. Lucet JC, Chevret S, Durand-Zaleski I, Chastang C, Regnier B: Prevalence and risk factors for carriage of methicillin-resistant *Staphylococcus aureus* at admission to the intensive care unit: results of a multicenter study: Archives of Internal Medicine. 2003; 163:181–188.

33. Harbarth S, Sax H, Fankhauser-Rodriguez C, Schrenzel J, Agostinho A, Pittet D: 2006. Evaluating the probability of previously unknown carriage of MRSA at hospital admission: American Journal of Medicine. 2006; 119:275.e15–23.

34. Huang SS, Rifas-Shiman SL, Warren DK, Fraser VJ, Climo MW, Wong ES, Cosgrove SE, Perl TM, Pottinger JM, Herwaldt LA, Jernigan JA, Tokars JL, Diekema DJ, Hinrichsen VL, Yokoe DS, Platt R: Improving methicillin resistant *Staphylococcus aureus* surveillance and reporting in intensive care units: Journal of Infectious Disease. 2007; 195:330–338.

35. Bhat SS, Hegde SK, Salian S: Potential of mobile phones to serve as a reservoir in spread of nosocomial pathogens. Online Journal of Health and Allied Sciences. 2011; 10(2):14-16.
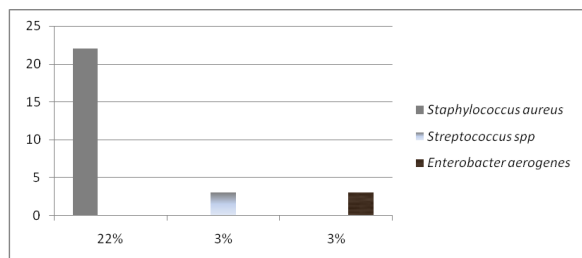
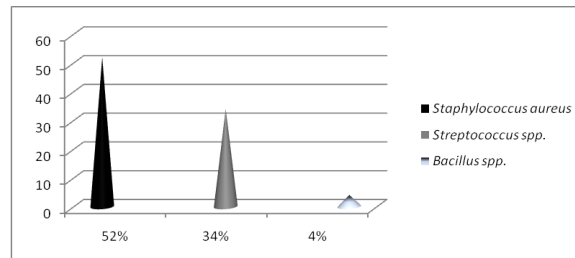*Figure 1:* Percentage occurrence of bacterial isolates on hands swab of nursing staff

Figure 2: Percentage of occurrence of bacterial isolates on mobile phones of nursing staff

Table 1: Antibiotic sensitivity test for *Staphylococcus aureus* (Disc diffusion method)

Sample	Zone of inhibition in mm				
	Streptomycin	Ciprofloxacin	Penicillin	Amoxicillin	Erythromycin
01	30±0.2	15±0.1	9±0.4	18±0.2	32±0.1
02	11±0.3	00	00	13±0.1	8±0.2
03	25±0.1	08±0.2	21±0.2	29±0.1	13±0.3
04	21±0.1	25±0.1	22±0.1	31±0.2	29±0.3
05	24±0.2	28±0.4	25±0.3	36±0.2	12±0.4

Values are mean four replicates ± SE

Table 2: Antibiotic sensitivity test for *Bacillus* species (Disc diffusion method)

Sample	Zone of inhibition in mm				
	Streptomycin	Ciprofloxacin	Penicillin	Amoxicillin	Erythromycin
01	20±0.1	09±0.1	07±0.3	09±0.2	19±0.1

Values are mean four replicates ± SE

Table 3: Antibiotic sensitivity test for *Enterobacter aerogenes* (Disc diffusion method)

Sample	Zone of inhibition in mm

	Streptomycin	Ciprofloxacin	Penicillin	Amoxicillin	Erythromycin
01	27±0.3	24±0.1	17±0.4	22±0.2	26±0.1
02	14±0.2	8±0.2	7±0.1	15±0.3	18±0.1

Values are mean four replicates ± SE

Table 4: (Sample1) - Antibiotic Sensitivity pattern for *Staphylococcus aureus* (Cup diffusion method)

Sl. No.	Different concentration of Antibiotics	Zone of inhibition measured in mm				
		Control (dist. water)	10 ppm	25 ppm	55 ppm	75 ppm
01	Oflaxacin	-	-	-	-	1±0.3
02	Ciprofloxacin	-	-	5±0.1	2±0.2	15±0.3
03	Amoxicillin	-	-	2±0.3	-	12±0.1
04	Levofloxacin	-	14±0.1	15±0.2	2±0.2	22±0.3

- → nil, Values are mean four replicates ± SE

Table 5: Antibacterial sensitivity pattern of *Staphylococcus aureus* isolated from HCWs (Cup diffusion method)

Sl. No.	Different Antibiotics	Zone of inhibition measured in mm				
		Control (dis. water)	10 ppm	25 ppm	55 ppm	75 ppm
01	Oflaxacin	-	-	12±0.2	12±0.2	14±0.3
02	Ciprofloxacin	-	-	12±0.4	16±0.2	18±0.3
03	Amoxicillin	-	2±0.5	13±0.1	16±0.1	18±0.4
04	Levofloxacin	-	12±0.4	12±0.3	18±0.2	19±0.3

Values are mean four replicates ± SE