

# Carriage of Multidrug Resistant Bacteria on Frequently Contacted Surfaces and Hands of Health Care Workers

SOWNDARYA VISALACHY<sup>1</sup>, KENNEDY KUMAR PALRAJ<sup>2</sup>, SRIDHARAN SATHYAMOORTHY KOPULA<sup>3</sup>, UMA SEKAR<sup>4</sup>

## ABSTRACT

**Introduction:** Maximal contact between the patients and Health Care Workers (HCWs) happens in the Intensive Care Units (ICU). Control of nosocomial infections requires compliance with hand hygiene and contamination free surfaces.

**Aim:** To determine the colonization of potential pathogens in the hands of HCWs and frequent contacted environmental surfaces.

**Materials and Methods:** A cross sectional study was conducted between September 2012 and May 2013 at Sri Ramachandra Medical College and Hospital. A total of 327 samples were collected using Glove juice technique from hands and swabs from frequently contacted surfaces. A sum of 157 samples were collected by glove juice technique from the hands of HCWs which included Consultants (20), Internees (3), Residents (10), Staff nurse (102) and support staff (22). A total of 170 samples were collected through swabbing which included frequently touched surfaces of apron and dress (140 which included 10 consultants, 3 interneees, 9 Residents, 101 Staff nurse and 17 support staff), 9 door handle, 4 key board, 12 tap handles and 5 monitors. The samples were inoculated into Blood agar, Chocolate agar and Mac-Conkey agar plates and incubated at 37°C aerobically. The plates showing growth were further processed to identify the organisms by Gram staining and biochemical reactions. Antibiotic susceptibility testing was done for the isolates by Kirby-baur disc diffusion method as per CLSI guidelines.

**Results:** Out of the 157 hand sampling done by glove juice method 67(42.7%) of them showed growth and 90(57.3%) showed no growth. The potential pathogens grown were 13 (8.3%), consisting of Methicillin Sensitive *Staphylococcus aureus* (MSSA) 6(3.8%), Methicillin Resistant *Staphylococcus aureus* (MRSA) 2(1.3%), *Pseudomonas* spp 4(2.6%) and *Acenitobacter* spp 1 (0.6%). The MRSA was seen in Consultant 1(5%; n=20) and Staff nurse 1(0.9%; n= 102). Among the 140 sampling from the dress of HCWs growth was observed in 69(49.3%) and growth was absent in 71(50.7%). The potential pathogens observed were 14(10%) and they are MSSA 5(3.6%), MRSA 1 (0.7%), *Pseudomonas* spp 2(1.4%), *Acenitobacter* spp 3(2.1%) *Enterobacter* spp 1(0.7%), *Klebseilla pneumoniae* 1(0.7%) and *Candida* spp 1(0.7%). One MRSA was isolated from staff nurse (0.9%; n=101). Similarly multi-drug resistant *Klebsiella pneumoniae* 1(0.9%; n=102). Out of the 30 environmental samples 16(53.3%) showed growth and in 14(56.7%) growth was absent. The potential pathogens isolated were 3(10%) which included MSSA 2(6.6%) and MRSA 1(3.4%) and were isolated from the monitor.

**Conclusion:** Adherence to infection control practices among all categories of HCWs is must for control of HAI. Glove juice method is a simple, easy and practical technique for determination of colonization of hands of HCWs and can be adapted as a methodology for screening the hands of HCWs.

**Keywords:** Glove juice, Hospital acquired infections, Surveillance

## INTRODUCTION

Nosocomial infections are a major threat in most of the hospitals and as high as 19% in the developing countries [1], especially in the Intensive Care Units (ICU), where number of direct contacts between the hands of Health Care Workers (HCW) and the patient occurs, which mandates the strict adherence to infection control practices and standards. The same standards are applicable for the equipment used, as many of the potential pathogens can survive for weeks in the inanimate surfaces. In the ICU, patients are often exposed to multiple procedures, invasive devices etc., increasing their chances of contracting such potential pathogens. Most of the time these potential pathogens exhibit Multiple drug resistance. Multiple Drug Resistant (MDR) organisms are microorganisms (predominately bacteria) resistant to more than one class of microbial agents. Even though MRSA (Methicillin Resistant *Staphylococcus aureus*) or VRE (Vancomycin Resistant Enterococcus) are resistant to only one class of antimicrobial agents they are frequently associated with resistance to other classes [2]. MRSA is worldwide a major cause for Hospital Acquired Infections (HAI). The prevalence of MRSA ranges from 20-80% in India [3]. Similarly, among the gram negative bacteria a major concern is

the production of new beta-lactamases which are capable of degrading cephalosporins and carbapenams. Infections with such organisms increase the morbidity, mortality, hospital stay and cost of treatment. Patients are inevitably exposed to higher antibiotics and other drugs which may result in further complications. A reduced HAI Rate and good compliance to infection control practices contributes to the reputation of the hospital. In view of the above factors, this study was undertaken to determine the rate of colonization of potential pathogens in the hands of HCWs and hospital environment using glove juice technique for hands and swab cultures for frequent touch surfaces.

## MATERIALS AND METHODS

A cross-sectional study was conducted after the approval of Institution ethics committee (REF: CSP/12/SEP/25/123), between September 2012 and May 2013 at Sri Ramachandra Medical College and Hospital, a tertiary care centre with 1900 inpatient beds. A total of 327 samples were collected out of which 157 samples were collected from the hands of Consultants (20), Interns (3), Residents (10), Staff nurse (102) and Support staff (22) by glove juice method, 140 samples were collected through swabbing from

the frequently contacted surfaces of the dresses of Consultants (10), Interns (3), Residents (9), Staff nurse (101) and Support staff (17). Similarly 30 environmental samples were collected through swabbing from Computer keyboards (4), Monitors (5), Door handle (9) and Tap handle (12). The samples were collected during the peak working hours of intensive care units and high dependency wards without any prior intimation. Glove juice technique [4] was adopted for collecting the samples from the hands. The hands of the HCWs were introduced into a non-powdered sterile glove containing 50 ml of phosphate buffer solution and the glove was tied with rubber band at the wrist. The hand was massaged for 60 seconds and 1ml of the fluid was pipetted out from the gloves into a sterile test tube. Standard swabbing method was adopted for collecting samples from the HCWs dress and environment using sterile swabs procured from Hi media laboratories private limited, India.

The collected samples were transported to Clinical Microbiology section of Central laboratory services in cold packs within two hours of collection for further processing. The samples were inoculated onto Blood agar, Chocolate agar and Mac-Conkey agar plates which were appropriately labelled with study subject details. The plates were incubated at 37°C aerobically. The plate readings were done at the end of 24 hours and 48 hours, and the findings were recorded. The plates which did not show any growth even after 48 hours were deemed sterile. Those plates which showed growth was further processed to identify the organisms by performing gram staining and appropriate biochemical reactions. Antibiotic susceptibility testing was done by Kirby-baur disc diffusion method. In case of *Staphylococcus* spp MRSA screening was done using cefoxitin 30µg disc, other discs used were ampicillin 10µg, cefotaxime 30µg, gentamycin 10µg, erythromycin 15µg, ciprofloxacin 5µg and linezolid 30µg. Susceptibility to vancomycin was determined by MIC (Minimum Inhibitory Concentration) method. All gram negative bacteria were tested with ampicillin 10µg, cephalixin 30µg, ceftazidime 30µg,

ceftazidime 30µg with clavulanic acid 10µg (ESBL screening), amikacin 30µg, ciprofloxacin 5µg, imipenem 10µg, etrapenam 10µg and meropenem 10µg. The antibiogram results were interpreted as per 2012 CLSI guidelines [5]. The quality controls of the swabs and the medium used for the study was ensured by standard quality control procedural methods.

## RESULTS

Out of 157 samples taken from hands of HCWs by Glove juice method 67(42.7%) showed growth 97(57.3%) no growth. The potential pathogens isolated were 13(8.3%). Among which MRSA were 2(1.3%). No MDR organism was isolated [Table/Fig-1]. Among the 140 samples taken by swab from the HCWs dress frequent contact surfaces 69 (49.3 %) had growth and 71 (50.7%) showed no growth. Potential pathogens grown were 14(10%) [Table/Fig-2] among which 1 (0.7%) was MRSA and MDR isolate *Klebsiella pneumoniae* 1(0.7%). Out of 30 samples taken by swabbing from environmental surfaces growth was seen in 16(53.3%) and no growth in 14(46.7%). The potential pathogens grown were 3 (10%) out of which 1(3.3%) was MRSA isolated from monitor [Table/Fig-3]. The commensals isolated were *Micrococci* spp 105(32.1%; n= 327), *Bacillus subtilis* 26(7.9%; n= 327), Coagulase Negative *Staphylococci* (CONS) 3(0.91%; n= 327).

## DISCUSSION

In this study the carriage of potential pathogens in the hand of HCWs was 8.3%(13) out of which MRSA was 1.3%(2), MSSA 3.8%(6) and others were Gram negative bacilli 3.2%(5) and all the gram negative isolates were sensitive strains. The hands of the staff nurse harboured 11(84.6%; n=13) of potential pathogens and remaining 2(15.4%; n=13) by consultant. Staff nurses and the consultants are the people who frequently come in contact with the patients especially in the ICU set up in the form of patient care and for therapeutic purpose. Health care workers hand remains the common vehicle for the nosocomial pathogens to cross

Organism	Consultants (n=20)	Residents (n=10)	Internee (n=3)	Staff Nurse (n=102)	Support Staff (n=22)	Total (157)
<i>Bacillus subtilis</i>	2(10%)	1(10%)	0	9(8.8%)	0	12
<i>Micrococci</i> spp	4(20%)	5(50%)	1(33.3%)	33(32.3%)	6(27.3%)	49
MSSA	1(5%)	0	0	5(4.9%)	0	6
MRSA	1(5%)	0	0	1(0.9%)	0	2
<i>Pseudomonas</i> spp	0	0	0	4(3.9%)	0	4
<i>Acenitobacter</i> spp	0	0	0	1(0.9%)	0	1
Total Growth	8(40%)	6(60%)	1(33.3%)	46*(45.1%)	6(27.3%)	67(42.7%)
Total No Growth	12(60%)	4(40%)	2(66.7%)	52 (54.9%)	16(72.7%)	97(57.3%)

**[Table/Fig-1]:** Segregation of organisms isolated from the hands of HCWs by glove juice method.

\* 7 samples showed growth of 2 organisms

Organism	Consultant (n=10)	Residents (n=9)	Internee (n=3)	Staff Nurse (n=101)	Support Staff (n=17)	Total (n=140)
<i>Bacillus subtilis</i>	2(20%)	1(11.1%)	0	9(8.9%)	2(11.8%)	14
<i>Micrococci</i> spp	2(20%)	1(11.1%)	0	34(33.7%)	6(35.2%)	43
CONS	0	2(22.2%)	0	1(0.9%)	0	3
MSSA	0	0	0	4(3.9%)	1(5.9%)	5
MRSA	0	0	0	1(0.9%)	0	1
<i>Pseudomonas</i> spp	0	0	0	2(1.9%)	0	2
<i>Acenitobacter</i> spp	0	0	0	3(2.9%)	0	3
<i>Enterobacter</i> spp	0	0	0	0	1(5.9)	1
<i>Klebsiella pneumoniae</i>	0	0	0	1(0.9%)	0	1
<i>Candida</i> spp	0	0	0	0	1(5.9%)	1
Growth	4(40)	4(44.4%)	0	51*(50.5%)	10**(58.8%)	69(49.3%)
NO Growth	6 (60%)	5(55.6%)	3(100%)	50(49.5%)	7(41.2%)	71(50.7%)

**[Table/Fig-2]:** Segregation of organisms isolated from the environment by swabbing method.

\*4 samples showed the growth of 2 organisms

\*\* 1 sample showed the growth of 2 organisms

Organism	Keyboard n=4	Monitor (n=5)	Door Handle (n=9)	Tap handle (n=12)	Total (n=30)
<i>Micrococci</i> spp	3 (75%)	1 (20%)	3 (33.3%)	6	13
MSSA	1 (25%)	0	1 (11.1%)	0	2
MRSA	0	1 (20%)	0	0	1
Total Growth	4 (100%)	2 (40%)	4 (44.4%)	6 (50%)	16
No Growth	0	3 (60%)	5 (55.6%)	6 (50%)	14

**[Table/Fig-3]:** Segregation of organisms isolated from the environment by swabbing method.

contaminate between the patients and the hospital environment [6]. WHO in 2009 has launched guidelines for hand hygiene based on the patient safety work programme "Save lives: Clean Your Hands" [7]. Magill SS et al., in a point prevalence survey of health care associated infections based on acute care hospitals in US has stated that 1 in 25 hospital patients suffer from health care associated infections [8]. Albrich WC in his review of literature from January 1980 to March 2006 reported 5% MRSA colonization in the hands of HCWs [9]. Gebreyesus A and Creamer E in their study have found 6.2% and 5% of HCWs carrying MRSA in their hands respectively [10,11]. MRSA another threat in the HAI was equally distributed in the hands of staff nurse and consultants' one each in our study. Adherence to strict hand washing protocols before and after touching the patients with recommended hand disinfectants will definitely bring down the MRSA carriage in these individuals there by bringing down its infections rates. Colonization of MRSA and other potential pathogens in non-critical objects like neck ties, aprons, stethoscopes and high touch surfaces like door handles, computer monitors and tap handles has been observed in many studies [12,13]. Treacle AM in his study on white overcoats of HCW has reported 18% of MRSA carriage [14]. In contrast, the carriage rate observed in the present study our study is only 0.9%. Hardy KJ correlated the relationship between environmental contamination with MRSA and patients' acquisition of MRSA and found 3 out of 26 patients with MRSA infection acquired them from the environment [15]. In this study 1(3.3% n=30) MRSA was isolated from monitor. ICU monitors are being frequently handled by the staff nurses and Consultants which remains as source and reservoir for MRSA and other gram negative isolates. The organism can be either transferred or transmitted from these sources to HCWs. Ultimate care and cleaning of these critical inanimate objects plays a major role in inhibiting the cross contaminating infections. In this study we adapted glove juice method for sampling the hands of HCWs instead of the standard EN 1500 technique which were used for testing the efficacy of hand rubs by plate contact method. Glove juice method was chosen as it ensures the collection of sample from the dorsum area, palmar area and also from the web spaces of the hands. However as per Kampf G the efficacy to recover the resident flora of hand by both the methods had no significant difference and glove juice method was superior to the European standard [16]. Moreover our objective was to look for the presence of microorganisms and not to quantify them.

## LIMITATION

One limitation of this study is that the HAI prevailing during the study period was not compared. Molecular typing of the isolates from the patients and HCWs could have thrown light on the source and extent of transmission within the hospital environment.

## CONCLUSION

HAIs are preventable, when infection control practices are strictly adhered to. Effective infection control measures includes surveillances cultures, outbreak related MRSA screening among the health workers, supervision of hand wash techniques by the infection control committee. Adequate education to HCWs regarding the hand washing protocols, frequent cleaning of hospital environment with disinfectants and wearing disposable aprons all contributes for bringing down the hospital acquired infection rate. Glove juice method is a simple, easy and practical technique for determination of colonization of hands of HCWs.

## REFERENCES

- [1] Maheshwari V, Kaore NCM, Ramani VK, Gupta SK, Borle A, et al. A study to assess knowledge and attitude regarding hand hygiene amongst residents and nursing staff in a tertiary care setting of bhopal city. *J Clin Diagn Res.* 2014;8(8):DC04-07.
- [2] Siegel JD, Rhinehart E, Jackson M, Chairello L. Health care infection control practices advisory committee. management of multidrug-resistant organisms in health care settings. *Centers for Disease Control and Prevention, Atlanta, GA* 2006.
- [3] Shanthy M, Uma S. Antimicrobial susceptibility pattern of methicillin resistant *Staphylococcus aureus* at sri ramachandra medical centre. *Sri Ramachandra Journal of medicine.* 2009;2(2):1-4.
- [4] American Society for Testing and Materials International. "ASTM E 1174-06: Standard test method for evaluation of the effectiveness of healthcare personnel handwash formulations". West Conshohocken, PA: American Society for Testing and Materials; 2006.
- [5] CLSI. Performance Standards for Antimicrobial Susceptibility Testing; Twenty-second Informational Supplement. CLSI document M100-S22. Wayne P A: Clinical and laboratory Standard Institute; 2012.
- [6] Allegranzi B, Pittet D. Role of Hand Hygiene in Health Care- Associated Infection Prevention. *Journal of Hospital Infection.* 2009;73(4):305-15.
- [7] World Health Organization. WHO Guidelines on Hand Hygiene in Health Care: First Global Patient Safety Challenge: Clean Care is Safer Care. Geneva, Switzerland: World Health Organization, Patient Safety; 2009.
- [8] Magill SS, Edwards JR, Bamberg W, Beldavs ZG, Dumyati G, Kainer MA, et al. Multistate point-prevalence survey of health care – associated infections. *N Engl J Med.* 2014;370:1198-208.
- [9] Albrich WC, Harbarth S. Health-care workers: source, vector, or victim of MRSA? *Lancet Infect Dis.* 2008;8:289-301.
- [10] Gebreyesus A, Gebre-Selassie S, Mihert A. Nasal and hand carriage rate of methicillin resistant *Staphylococcus aureus* (MRSA) among health care workers in mekelle hospital, north ethiopia". *Ethiop Med J.* 2103;51(1):41-7.
- [11] Creamer E, Dorrian S, Dolan A, Sherlock O, Fitzgerald-Hughes D, Thomas T, et al. When are the hands of healthcare workers positive for methicillin-resistant *staphylococcus aureus*? *J Hosp Infect.* 2010;75(2):107-11.
- [12] Ditchburn I. Should doctors wear ties? *J Hosp Infect.* 2006;63(2):227-28.
- [13] Madar R, Novakova E, Baska T. The role of non-critical health care tools in the transmission of nosocomial infections. *British Lek Listy.* 2005;106:348-50.
- [14] Treacle AM, Thom KA, Furuno JP, Strauss SM, Harris AD, Perencevich EN. Bacterial contamination of health workers white coats. *Am J Infect Control.* 2009;37(2):101-05.
- [15] Hardy KJ, Oppenheim BA, Gossain S, Gao F, Hawkey PM. A study of the relationship between environmental contamination with methicillin resistant *Staphylococcus aureus* (MRSA) and patients acquisition of MRSA. *Infect Control Hosp Epidemiol.* 2006;27(2):127-32.
- [16] Kampf G, Ostermeyer C, Heeg P, Paulson D. Evaluation of two methods of determining the efficacies of two alcohol-based hand rubs for surgical hand antiseptics. *Appl Environ Microbiol.* 2006;72:3856-61.

### PARTICULARS OF CONTRIBUTORS:

1. Internee, Sri Ramachandra Medical College & Research Institute, Sri Ramachandra University, Porur, Chennai, India.
2. Associate Professor, Department of Microbiology, Sri Ramachandra Medical College & Research Institute, Sri Ramachandra University, Porur, Chennai, India.
3. Associate Professor, Department of Microbiology, Sri Ramachandra Medical College & Research Institute, Sri Ramachandra University, Porur, Chennai, India.
4. Professor and Head of Department, Department of Microbiology, Sri Ramachandra Medical College & Research Institute, Sri Ramachandra University, Porur, Chennai, India.

### NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Kennedy Kumar Palraj,  
No 25 First School Street, Chattriram, Pattabiram, Chennai-600072, India.  
E-mail: kennychennai1973@gmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Feb 23, 2016**  
Date of Peer Review: **Mar 04, 2016**  
Date of Acceptance: **Mar 25, 2016**  
Date of Publishing: **May 01, 2016**