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**EFFECT OF HAND WASHING AMONG NURSING STAFFS IN TERTIARY CARE HOSPITAL : A STUDY**

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**ABSTRACT**

**Background and objective:** Health care Associated Infection (HAI) is a major problem worldwide. Contaminated hands of health care workers (HCWs) play an important role in the transmission of pathogens. Hand washing is considered to be the most effective method for preventing the transmission of micro-organisms between HCWs and patients. Hence the present study was undertaken to detect the microorganisms present on the hands of Nursing staffs before and after hand washing, in a tertiary care hospital.

**Method:** Swabs were collected from 150 nursing staffs working in various wards and Intensive Care Units (ICUs), from hands before and after hand washing with antimicrobial soap. Swabs were inoculated on blood agar and Mac-Conkey's agar. Microorganisms were identified by standard methods. Detection of HAI pathogens were done according to Clinical Laboratory Standard Institute (CLSI) guidelines.

**Result:** Out of total 150 samples collected before hand washing, growth was observed in 107 (71.3%) samples and no growth in 43 (28.7%) samples. Apart from skin commensals, *Staphylococcus aureus* (20.1%), *Enterococcus faecalis* (4.6%), *Klebsiella pneumoniae* (6%), *E.coli* (4%) and *Pseudomonas aeruginosa* (1.3%) were detected. 05 Methicillin Resistant *Staphylococcus aureus* (MRSA) strains were also isolated from hand swabs collected before hand washing. No growth was obtained in 128 (85.3%) samples and growth were observed in 22 (14.7%) samples after hand washing.

**Conclusion:** It is important to perform proper procedure of hand washing technique using an adequate quantity of antimicrobial soap to cover all skin surfaces for the recommended length of time.

**Keywords:** Health care Associated Infection (HAI), Hand hygiene

**INTRODUCTION**

Health care associated infection (HAI) is a major problem for patient's safety and its surveillance. Prevention of HAI must be a first priority for every health care set up and institutions committed to making health care safer. The impact of HAI implies prolonged hospital stay, long-term disability, increased resistance of microorganisms to antimicrobials, massive additional financial burden for patients and their families and increased mortality.<sup>1,2</sup>

In the mid-1800s, studies by Ignaz Semmelweis in Vienna, Austria, and Oliver Wendell Holmes in Boston, USA, established that organisms causing puerperal sepsis were transmitted via the hands of Physicians and Medical students who performed autopsy and directly entered the labour room. Semmelweis is considered not only the Father of Hand Hygiene, but his intervention is also a model of epidemiologically driven strategies to prevent infection. Many other investigations conducted over the past 40 years have confirmed that contaminated hands of Health Care Worker

(HCW) play an important role in the transmission of health care-associated pathogens e.g Methicillin Resistant *Staphylococcus aureus* (MRSA), Vancomycin resistant Enterococci (VRE) and Extended Spectrum  $\beta$ -lactamases(ESBL) , Amp C  $\beta$ -lactamases or Carbapenemases producing Gram negative bacilli.<sup>3,4,5,6</sup>

Bacteria present on the hands could be divided into two categories, namely resident or transient.

- **Resident flora** : Organisms like Coagulase Negative *Staphylococci* i.e. CONS (*Staphylococcus epidermidis* ,*Staphylococcus hominis* ,Oxacillin Resistant CONS ), Diphtheroids,Propionibacteria, Micrococci and *Candida sp.*,*Pityrosporum* (*Malassezia*) may survive and multiply in superficial layers of skin.
- **Transient flora**: These organisms colonize superficial layers of skin and can be easily removed by routine hand hygiene. They can be pathogens like Gram negative bacteria or *Staphylococcus aureus* and are acquired by HCWs from colonized or infected patients or from inanimate objects in the patient's immediate environment and are the organisms most frequently to cause HAIs.<sup>7,8</sup>

The transmissibility of transient flora depends on the microorganism present, the number of microorganisms on the surface, and the skin moisture<sup>9,10</sup> Various studies have reported that total bacterial counts on the hands of HCWs have ranged from  $3.9 \times 10^4$  to  $4.6 \times 10^6$  colony forming unit /  $\text{cm}^2$  (CFU) and fingertip contamination ranged from 0 to 300 CFU.<sup>3,4,5,6</sup>

Hence the present project was undertaken to study the bacterial flora present on the hands of Nursing staffs before and after hand washing with antimicrobial soap and water.

## MATERIAL AND METHODS

This cross sectional study was conducted in Department of Microbiology. The project was approved by Institutional Ethics committee. 150 Nursing staffs working in various wards and ICUs

of a tertiary care hospital in a rural set up were included in this study. Total number of 150 swabs (sterile swabs moistened with sterile saline) were collected from various sites of the hands (palm, web spaces, fingertip and beneath nail) before hand washing.

The Nursing staffs were told to wash their hands with antimicrobial soap performing all steps within specified time (15-20seconds).They were instructed not to touch the tap after washing hands and air dry their hands. After completely drying their hands, another swab from above mentioned sites were taken. All swabs were inoculated on blood agar and Mac-Conkey's agar and incubated at  $37^\circ\text{C}$  overnight and examined for microbial growth. The microorganisms were identified by standard methods.<sup>11</sup> Detection of Methicillin Resistant *Staphylococcus aureus* (MRSA) using Cefoxitin disc 30  $\mu\text{g}$  and ESBL producing organisms by combined disc method (Ceftazidime 30  $\mu\text{g}$  and Cefdzidime + Clavulanic acid disc 30/10  $\mu\text{g}$ ) were carried out.<sup>12</sup>For detection of Carbapenemase producing Enterobacteriaceae, Modified Hodge test was done. For detection of HLAR (High level aminoglycoside resistant) Enterococci, High Level Gentamicin disc 120  $\mu\text{g}$  and for Vancomycin Resistant Enterococci (VRE) , VRE agar having Vancomycin 6  $\mu\text{g}/\text{ml}$  was used as per Clinical Laboratory Standard Institute ( CLSI) guidelines.<sup>12</sup> Statistical analysis was done by standard statistical methods.<sup>13</sup>

## RESULTS

Total 150 Nursing staffs working in various wards, ICUs and OT complexes were included in the study. Maximum staffs 36 ( 24%) were from Medicine ward followed by Surgery 27 (18%) and Pediatrics 27(18% ).(table1) Amongst 36 Nursing staffs from medicine ward , 28 Nursing staffs (77.7% ) had growth before hand washing. Though the number of Nursing Staffs from each specialties included in other wards were less,

18(85.7%) Nursing Staffs had growth before hand washing.

Out of total 150 samples collected before hand washing, growth of microorganisms was observed in 107(71.3%) samples and no growth in 43

(28.7%) samples. Growth of microorganisms were  $>10^3$  colony forming unit (CFU) in all the samples. Out of 107 samples showing growth, 55 (51.4%) samples showed single type of bacteria, 41 (38.3%) showed two types of bacteria while 4 (3.7%) samples showed three types of bacteria.

Out of 30 *Staphylococcus aureus* strains isolated from hands of Nursing Staff before hand washing 5(16.6%) were MRSA. (table2) (photo 1) Out of 17 Gram negative bacilli isolated, 6 (35.2%) were ESBL producers(*Klebsiella pneumoniae* 4,*E.coli* 2) (photo 2) but no Carbapenam resistant Enterobacteriaceae (CRE) or Carbapenamase producing Gram negative bacilli were isolated. 07 (4.6%) *Enterococcus faecalis* were isolated and all of them were High Level Aminoglycoside resistant. No vancomycin Resistant Enterococci (VRE) was detected in the present study. Two *Enterococcus faecalis* strains showed vancomycin sensitivity in the intermediate range (15-16 mm) and were repeated thrice. These two strains did not grow on VRE agar and hence were considered as Vancomycin sensitive.

After hand washing with antimicrobial soap and water, no growth was obtained in 128 (85.3%) samples and single type of growth in 22 (14.7%) samples. Growth of microorganisms was in between 50- 100 CFU. Apart from skin commensals, MSSA were detected in 22.7% samples.(table 3)

After hand washing, improvement was observed as there was no isolation of MRSA, *Enterococcus* species and Gram negative bacilli and hence no ESBL producers.

If the number of samples positive before and after hand washing is considered, statistical analysis reveals standard error of difference is 4.7, whereas the observed difference is 56.6. Since the observed difference between two groups is much more than

twice the Standard Error of difference ( $2 \times 4.7 = 9.4$ ), we hereby conclude that efficacy of hand washing is significantly higher than without i.e. before hand washing.<sup>13</sup>

## DISCUSSION

Cross-transmission of organisms occurs through contaminated hands. HAI pathogens especially Multidrug resistant organisms (MDROs) e.g .Methicillin Resistant *Staphylococcus aureus* (MRSA), Vancomycin resistant Enterococci (VRE) and Extended Spectrum  $\beta$ -lactamases (ESBL), Amp C  $\beta$ -lactamases or Carbapenamases producing Gram negative bacilli are transmitted by contaminated hands of HCWs. Hands also play important role in transmission of blood borne, faecal and respiratory tract viruses.<sup>14-21</sup> Transmission of pathogens from one patient to another via HCWs' hands requires five sequential steps.<sup>14</sup>

- Organisms present on the patient's skin, or shed onto inanimate objects in immediate vicinity of the patient;
- Organisms transferred to the hands of HCWs;
- Survival of organisms on HCWs' hands;
- Inadequate or entirely omitted hand washing or hand antisepsis or inappropriate agent used by the HCW
- The contaminated hands of HCWs must transmit the microorganisms to another patient directly or via inanimate object.

Factors influencing the transfer of microorganisms from surface to surface and cross-contamination rates are organisms involved, source and destination surfaces, moisture level and size of inoculum.

In the present study, before hand washing ,apart from skin commensals (micrococci, coagulase negative *Staphylococci* i.e.CONNS etc.), transient flora i.e. *Staphylococcus aureus* (20.1% ),Gram negative rods (11.4%) and *Enterococcus faecalis* (4.6 % ) were obtained.(fig 1) In our study, out of 30 *Staphylococcus aureus* isolated, 5 (16.6%) were MRSA and out of 17 Gram negative bacilli

isolated, 6 (35.2%) were ESBL producers and is a matter of concern. These organisms are potential threat of health care associated infection and also outbreak in health care set up. Several other studies have documented that HCWs can contaminate their hands or gloves with Gram-negative bacilli, *Staphylococcus aureus*, Enterococci or *Clostridium difficile* even by performing “clean procedures” or touching intact areas of skin of hospitalized patients or after touching inanimate objects.<sup>15-21</sup>

Ayliffe and colleagues<sup>22</sup> found that 15% of nurses working in an isolation unit carried a median of  $1 \times 10^4$  CFU of *Staphylococcus aureus* on their hands; 29% of nurses working in a general hospital had *Staphylococcus aureus* on their hands (median count  $3.8 \times 10^3$  CFU), while 78% of those working in a hospital for dermatology patients had the organism on their hands (median count,  $14.3 \times 10^6$  CFU). The same survey revealed that 17–30% of nurses carried Gram-negative bacilli on their hands (median counts ranged from  $3.4 \times 10^3$  CFU to  $38 \times 10^3$  CFU).

Daschner<sup>23</sup> found that *Staphylococcus aureus* could be recovered from the hands of 21% of ICU caregivers and that 21% of doctors and 5% of nurse carriers had  $>10^3$  CFU of the organism on their hands. A study conducted by Waters V et al in two neonatal ICUs revealed that Gram-negative bacilli were recovered from the hands of 38% of nurses.<sup>24</sup>

In the present study, after hand washing with antimicrobial soap, Micrococci (50%), *Staphylococcus aureus* (MSSA 22.7%), *Bacillus* species (18.1%) and CONS(9.09%) were detected. In these cases, it might be possible that nurses fail to perform appropriate technique of hand washing for recommended length of time. To avoid prolonged hand contamination, it is not only important to perform hand hygiene when indicated, but also to use the appropriate technique and an adequate quantity of the product to cover all skin surfaces for the recommended length of time.<sup>14,25</sup>

Hand hygiene practice and its compliance has been the core issue worldwide especially in developing countries. Poor hand hygiene practices in hospital has led to number of outbreaks and adverse outcomes.<sup>26</sup> The role of health care workers' hands in cross transmission of organisms is best illustrated by the striking example of the study conducted by Pittet et al, where a hospital wide hygiene campaign with emphasis on alcoholic hand rub led to a sustained increase in hand hygiene compliance and reduction in HAI by more than 40% and transmission of MRSA was reduced by more than 50%.<sup>27</sup> Promotion of hand hygiene has become an important initiative with most of the countries and efforts are to be strengthened worldwide to provide safe patient care.

## CONCLUSION

When health care workers do not follow the steps of hand hygiene between patient contact or during patient care, the microorganisms can be transmitted from patient to health care workers to other patients. It is important to perform proper procedure of hand washing technique using an adequate quantity of antimicrobial soap to cover all skin surfaces for the recommended length of time. We hereby conclude that efficacy of hand washing with antimicrobial soap is statistically significant in controlling the microorganisms on nurses hands than without hand washing.

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**Table 1: Incidence of Nursing Staffs from different clinical specialities having growth before Hand washing**

Clinical specialities	TotalNumber	Growth	%
Medicine: (ward-26, MICU-10)	36	28	77.7
Sugery	27	21	77.7
Paediatrics:(ward-11, NICU-9, PICU-7)	27	15	55.5
Orthopaedics	18	11	61.1
Gynaecology & Obstetrics	12	8	66.6
OT ICU	9	6	66.6
Others*	21	18	85.7
Total	150	107	

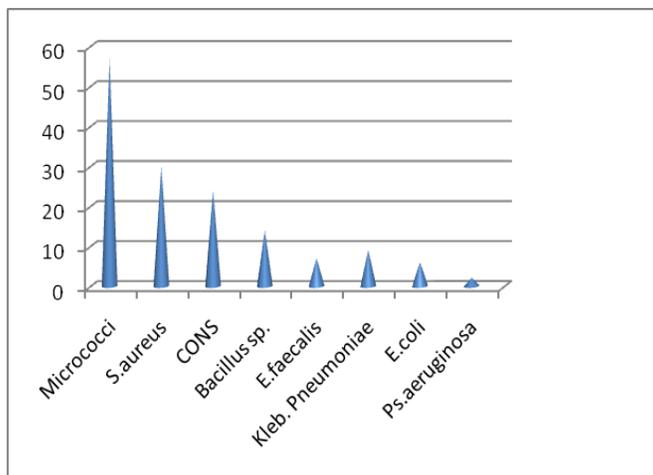
Others\* Include Ophthalmology (5), Neurosurgery(3), ENT(3), Tb chest(2), Psychiatry(2), Dermatology(2), Casualty(2), Cathlab (1)

**Table 2: Incidence of microorganisms isolated before hand washing from hands of Nursing staff (n=149)**

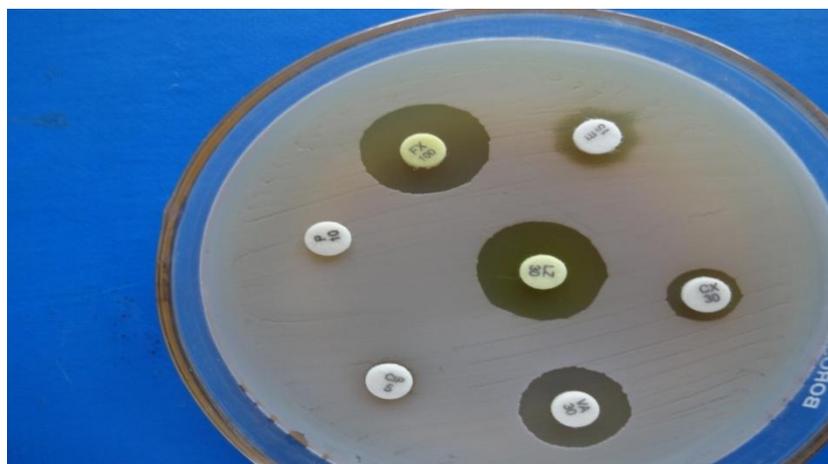
Organisms	Number	Percentage
Micrococci	57	38.2
S. aureus (MRSA 05, MSSA 25)	30	20.1
Coagulase negative Staphylococci	24	16.1
Bacillus species	14	9.3
Enterococcus faecalis	07	4.6
K. pneumoniae (ESBL 04, Non ESBL05)	09	6
E. coli(ESBL02, Non ESBL 04)	06	4
Pseudomonas aeruginosa	02	1.3
<b>Total</b>	<b>149</b>	

**Table 3: Incidence of various microorganisms isolated after hand washing. [n=22]**

Organisms	Number	Percentage %
Micrococci	11	50
Staphylococcus aureus-MSSA	05	22.7
Coagulase negative Staphylococci	02	9
Bacillus species	04	18.1
<b>Total</b>	<b>22</b>	



**Fig 1: Incidence of various microorganisms isolated before hand washing (n=149)**



**Photo 1: Detection of MRSA using Cefoxitin 30 µg disc**



**Photo 2: Detection of ESBL using combined disc method**