



## BACTERIOLOGICAL PROFILE OF HEALTH WORKERS HANDS WORKING IN VARIOUS ICUs OF A TERTIARY CARE HOSPITAL

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### ABSTRACT

Health Care Associated Infections cause increased morbidity and mortality among hospitalized patients especially in ICUs mainly contributed by the bioburden of health care workers (HCWs) hands. This study aims to assess the bacteriological profile of HCWs hands in various ICUs. The study included 80 HCWs; swabs taken from their hands were processed and characterized with antibiogram.

#### Summary:

1. Out of 80 HCWs, 67 showed bacterial growth and 13 were tested negative which showed a significant p value of <0.001.
2. A total of 77 organisms were isolated including CONS, Staphylococcus aureus, Klebsiella pneumoniae, NFGNB, Escherichia coli and Citrobacter koseri.
3. Majority of the isolates were multi-drug resistant. All Staphylococcal isolates were not MRSA and 5 GNB isolates were ESBL producers.
4. This study concludes the presence of multidrug resistant isolates in the hands of HCWs, implying poor compliance and emphasizes proper, adequate training of HCWs to improve their compliance towards hand hygiene practices.

**KEYWORDS** : Hand hygiene, Healthcare associated infection.

### Introduction:

Determined actions are required to address the burden due to health care-associated infections (HCAI) worldwide and improve patient safety.<sup>1,2</sup> Improving hand hygiene among health care workers (HCWs) is an essential intervention to achieve these goals because the hands of HCWs play a significant role in the transmission of nosocomial pathogens.<sup>3</sup> Microbial flora of the hand consists of resident (colonizing) and transient (contaminating) organisms. The transient microbial flora represents recent contaminants of the hands acquired from colonized / infected patients or contaminated environment or equipment. In contrast to the resident flora, the transient microorganisms found on the hands of the HCWs are more frequently implicated as the source of nosocomial infections. The most common transient flora includes Staphylococcus aureus and the Gram negative coliforms.<sup>3</sup> Eventually, maintaining proper hand hygiene has often been singled out as the most important procedure in preventing HCAI.<sup>4,5</sup>

With this note, in view of improving the hand hygiene status of HCWs, the WHO recommended the implementation of 'Your five moments for hand hygiene' strategy worldwide in 2009.<sup>1</sup> However, compliance by HCWs with the recommended hand hygiene procedures has remained unacceptable, with compliance rates generally below 50% of hand hygiene opportunities.<sup>6</sup> The factors contributing to such a low compliance rate are many – lack of knowledge about the importance of hand hygiene in reducing the spread of infection, lack of understanding of correct hand hygiene techniques, understaffing and overcrowding, poor access to hand washing facilities, irritant contact dermatitis associated with frequent exposure to soap and water, lack of institutional commitment to good hand hygiene, a perception that hand hygiene interferes with worker-patient relationships, and poor habits learned early in life.<sup>7-10</sup>

Among the above enlisted factors, a perceived lack of evidence that hand hygiene is effective in the prevention of HAI remains as a major hindrance from adhering to hand hygiene recommendations. "If you cannot measure it, you cannot improve it". These words from Irish physicist Lord Kelvin are often quoted in public health to justify the need for reliable surveillance data to evaluate the extent of a health issue and the impact of interventions for its prevention and control. The same applies for the maintenance of proper hand

hygiene by HCWs as well. Thus, a bacteriological screening of the HCWs hands will definitely prove useful in increasing their compliance towards hand hygiene practices. The resulting increase in compliance rates will be highly useful in reducing the morbidity and mortality of the patients and also the cost & duration of patient stay in a hospital. Maintaining proper hand hygiene is thus a highly economical infection control measure worldwide.

This study, thus chiefly focuses on revealing the bacterial burden of the hands of HCWs in various ICUs because, the morbidity and mortality of the already critically-ill can be greatly reduced, if the health care workers posted there can maintain a proper hand hygiene.

### Aims and objectives:

- 1) Bacteriological screening of HCWs hands in various ICUs.
- 2) Phenotypic characterization of the bacterial isolates for the presence of multidrug resistant organisms like MRSA and ESBL producing microbes among others.
- 3) Feedback of the hand screening microbiology report to the HCWs.

Ethical approval: The Ethical approval was obtained from the Institution Ethical committee.

### Materials and Methods:

The study was carried out in Medical, Surgical, Respiratory, Cardiac, Cardiothoracic, Neonatal, Pediatric and Maternal ICUs in association with Institute of Microbiology, of a tertiary care centre in South India. Out of the 120 HCWs selected, only 80 HCWs gave the consent for the study and divided in to four groups. Group I- CRRIs, Group II- PGs and Assistant professors, Group III- Staff Nurses, FNAs and technicians, Group IV- Nursing and other paramedical students.

### Specimen collection:

The details of the study were explained to the HCWs just before sampling, irrespective of their hand hygiene status. Thus, swabs were taken from both clean and unclean hands. This way, it was possible to check the overall hand hygiene status of all the HCWs of the ICUs at that particular moment, without any bias. After

obtaining consent from each one of them, samples were collected. Sterile swabs soaked in a freshly prepared solution of Glucose broth were used for sample collection. Swabs were taken from the following regions of both hands of a HCW – eminences, creases, inter-digital spaces, ulnar and radial borders, web spaces, sub-ungual and nail-bed regions. These are the sites of maximum bacterial burden (Pittet et al).<sup>11</sup>

Then, the specimens were transported to the Microbiology laboratory. The samples were inoculated in to MacConkey agar, Blood agar; Nutrient agar culture plates and they were incubated at 37°C for 16- 24 hours. Next day, the culture plates were examined for the growth and colony morphology. Then, preliminary tests like Gram staining, motility, catalase, and oxidase tests were done. Routine bio chemical tests like Indole test, citrate utilization, growth in TSI agar, sugar fermentation were also performed for identification of the isolates. For Gram positive cocci, coagulase test was performed to differentiate *Staphylococcus aureus* from Coagulase Negative *Staphylococci* (CONS).

Antibiotic susceptibility testing was done for the isolated bacteria using Kirby-Bauer disc diffusion method. Penicillin, Cefoxitin (as a surrogate marker for MRSA), Cotrimoxazole, Cefotaxime, Ciprofloxacin, Gentamicin, Erythromycin, Ampicillin and Vancomycin discs were used. Novobiocin discs were used for the speciation of the isolated CONS. Novobiocin sensitive CONS were taken as *Staphylococcus epidermidis* CLSI guidelines, were used for the interpretation of the results.

Methicillin resistance *Staphylococcus aureus* was detected by using Mueller- Hinton agar with Cefoxitin disc (30 micrograms), as a surrogate marker, by Kirby-Bauer disc diffusion method. A zone size of  $\geq 22$  mm was considered as sensitive and  $\leq 21$  as resistant (CLSI Guidelines).

ESBL screening was done for all Enterobacteriaceae. First, susceptibility testing was performed with both cefotaxime and ceftazidime, or with cefpodoxime alone. Then ESBL confirmatory tests were performed on isolates found to be non-susceptible to any of the above i.e. cefotaxime, ceftazidime and cefpodoxime. The Gram negative isolate with zone inhibition diameter  $\leq 27$ mm for cefotaxime 30 $\mu$ g disc and  $\leq 22$ mm for ceftazidime 30 $\mu$ g disc was considered as presumptive ESBL producer by Kirby-Bauer disc diffusion method. For ESBL producer, if Cefpodoxime 10 $\mu$ g disc was used alone, zone inhibition diameter value cut off was  $\leq 17$ mm.

**Data analysis:**

The data on how many HCWs tested positive and how many negative was analyzed by  $\chi^2$  (chi square) test using SPSS 20 software. The data was also calculated in terms of percentages.

The bacteriological screening report was provided to the Medical officer in-charge of the ICUs chosen. Reports were also provided to individual HCWs upon their request. Subsequently, information was provided on how their hands could transmit multi drug resistant pathogens. They were recommended to follow the WHO's 'My 5 Moments For Hand Hygiene' strategy.

**Results:**

A total of 80 samples were collected from 80 HCWs working in the following ICUs-Medical, Surgical, Respiratory, Cardiac, Cardiothoracic, Neonatal, Pediatric and Maternal ICUs.

The results of the study are summarized under the following headings

**I. Bacteriological screening report:**

The bacteriological screening result is as follows. The results are distributed among the four groups of HCWs chosen.

**Table 1:**

Category	No. of HCWs in that group	NIL bacterial growth	Bacterial growth present
CRRIs	6 (7.5%)	4 (5%)	2 (2.5%)
PGs and APs	12 (15%)	1 (1.2%)	11 (13.8%)
Staff Nurses, FNAs and Technicians	30 (37.5%)	3(3.8%)	27 (33.7%)
Nursing and other paramedical students	32 (40%)	5(6.3%)	27 (33.7%)
Total	80 (100%)	13 (16.3%)	67* (83.7%)

- Out of 80 HCWs, 13 people tested negative for bacterial isolates, while bacteria were isolated from the hands of the remaining 67 HCWs.
- $\chi^2$  (chi square) test gave a p value of <0.001. This reveals the above statistics to be highly significant in favour of poor hand hygiene.

The various bacterial isolates obtained were as follows

**Table 2:**

Nature of the isolate	Number
CONS	50 (65%)
<i>Staphylococcus aureus</i> (S. aureus)	12 (15.4%)
<i>Klebsiella pneumoniae</i> (K. pneumoniae)	10 (13%)
Non fermenting Gram negative bacilli (NF-GNB)	3 (4%)
<i>Escherichia coli</i> (E. coli)	1 (1.3%)
<i>Citrobacter koseri</i> (C. koseri)	1 (1.3%)
Total	77* (100%)

(NOTE- From tables 1 and 2, it is seen that the total number of bacterial isolates [77] is greater than the total number of HCWs who were positive for any isolate [67\*]. This is because more than one bacteria were isolated from the hands of a few HCWs)

The following table distributes the results among each study group

**Table 3:**

STUDY GROUP	CONS No & % (S. epidermidis)	S. aureus	Klebsiella pneumoniae	NF-GNB	Escherichia coli	Citrobacter Koseri
I.CRRIs	2 (4%)	0	0	0	0	0
II.PGs and APs	8 (16%)	2(16.6%)	1 (10%)	0	1 (100%)	0
III.Staff nurses, FNAs and Technicians	23 (46 %)	5(41.7%)	6 (60%)	3 (100%)	0	0
IV.Nursing and Other paramedical students	17 (34%)	5(41.7%)	3 (30%)	0	0	1 (100%)
TOTAL	N=50(100%)	N=12(100%)	N=10(100%)	N=3(100%)	N=1(100%)	N=1(100%)

**II. Antibigram report:**

The important results were

- All the isolated CONS were *Staphylococcus epidermidis* (Novobiocin sensitive)
- All the *Staphylococcus aureus* isolates were Methicillin sensitive
- No Methicillin resistant *Staphylococcus aureus* (MRSA) was isolated from the hands of the HCWs.
- The isolated *Escherichia coli* was sensitive to Gentamicin, Ciprofloxacin and Amikacin and resistant to Ceftazidime.
- The isolated *Citrobacter koseri* was sensitive to Amikacin and Ciprofloxacin and resistant to Penicillin and Gentamicin.

- Out of the ten isolates of *Klebsiella pneumoniae*, 4 were sensitive only to Amikacin, Gentamicin and Ciprofloxacin while resistant to all other drugs including III generation Cephalosporins and Penicillin group of Antibiotics (ESBL producers)
- The majority of the isolated CONS were resistant to commonly used drugs like Ampicillin, Cotrimoxazole, Ciprofloxacin, Gentamicin, and Erythromycin (Multi-drug resistant).

#### Discussion:

About 83.7% HCWs hands were found to be contaminated, which is a significant result-evident from the very low p value of <0.001 obtained in the Chi square analysis. This certainly emphasizes the point that their hand hygiene needs to be improved. The isolates were CONS (*Staphylococcus epidermidis*) (from 50 HCWs), *Staphylococcus aureus* (from 12 HCWs),

*Klebsiella pneumoniae* (from 10 HCWs), Non fermentative Gram negative bacilli (from 3 HCWs), *Escherichia coli* and *Citrobacter koseri* (each from 1 HCW). More than one isolate was obtained from a few HCWs. All the *S. aureus* isolates were Methicillin susceptible (No MRSA was isolated). The majority of the isolates were resistant to commonly used antibiotics. Out of the 10 isolates of *Klebsiella pneumoniae* 4 were ESBL producer, like that the only one isolate of *Escherichia coli* was also an ESBL producer. Among the 80 HCWs screened, the hands of 13 HCWs were found to be free from any bacterial isolate. This represents that population who might have washed their hands properly. As mentioned earlier, no prior information was provided to the HCWs regarding the study. Thus, 'at that moment' hand hygiene status was determined. Among the remaining 67 HCWs, a few others may have washed their hands too. But the proper procedure, as recommended by the WHO, might not have been followed leading to persistence of bacteria.

Most of the isolated bacteria were multidrug resistant. This is probably because of the widespread use of broad-spectrum antibiotic therapy to all the patients, leading to the development of drug resistance.

On receiving the culture report, every HCW vowed to adhere to the hand hygiene recommendations. The solid evidence of presence of bacteria did create a motive in their minds. Whether this actually did increase their compliance is yet to be found out. This can be the focus of a future study.

#### Conclusion:

It is evident that HCWs act as mechanical vectors for nosocomial pathogens, and also that their hand hygiene compliance is unacceptably low. Maintaining proper hand hygiene can not only reduce the infection rates, but also curtail the spread of multi-drug resistant microbes. A single intervention definitely does no good in increasing the compliance rates. The prevailing status should be improved through a multimodal hand hygiene strategy as rightly recognized by the WHO.

The HCWs must be properly and frequently educated on Hospital Acquired infection (HAI) through CME programs. Education and training must go hand in hand. Their behavioral changes regarding hand washing practices can be monitored and rewarded accordingly.

The role of fomites in HAI must be well emphasized so that every HCW strives to maintain hand hygiene even after touching a patient's surroundings. Proper hand hygiene facilities, for e.g. water supply, soaps, solutions and alcohol-based hand rubs, must be made available so that it becomes easier for HCWs to adhere to the recommended hand hygiene procedures. Proper sterilization of all the equipments and fumigation of the ICUs at regular intervals are also important means to reduce the rate of HAI.

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