EFFECTIVENESS OF HAND HYGIENE IN REDUCING BACTERIAL FLORA IN HEALTH CARE WORKERS-A STUDY OF IMPACT

Microbiology

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ABSTRACT

Introduction: Hand hygiene is simplest, most effective and least expensive tool to prevent health care worker associated infection. The compliance among HCW is low due to various reasons leading to increased morbidity and mortality in Healthcare associated infection (HAI). Proper hand hygiene significantly reduces bacterial flora and HAI. The study was planned with the aim to know the pattern of microbial flora and its drug resistance and effectiveness of hand hygiene in reducing bacterial load on hands of health care workers.

Material and Methods: Both hand finger imprints of 50 participants were taken on Blood agar before and after hand hygiene. The plates were incubated 24-48 hours at 37°C. Colony count was done. Bacteria were identified by their colony characteristics and biochemical reactions. AST was performed as per CLSI 2019 guidelines.

Results: 90-99% reduction in bacterial colony count after hand hygiene was seen in majority of participants. Mixed growth was seen in ten samples. Micrococcus was most common organism isolated in twenty-four samples, followed by diptheroids in sixteen samples, Coagulase negative staphylococcus (CoNS) in fourteen samples and *Staphylococcus aureus* in six samples. Three CoNS and four *Staphylococcus aureus* were Methicillin resistant. Gram negative bacilli isolated were *Klebsiella species*, *Pseudomonas species* and *Escherichia Coli* each in two samples respectively. One *Escherichia Coli* was ESBL producer. All the GNB were sensitive to carbapenem. After performing hand hygiene micrococcus was isolated from four sample, diptheroids from three and CONS from one sample. *Staphylococcus aureus* and GNB were not found after hand hygiene.

Conclusion: HCW hands are colonized with bacteria. Proper hand hygiene technique awareness and its compliance significantly reduce bacterial load and decrease HAI.

KEYWORDS

Hand hygiene, HCW, HAI, Colony Count.

INTRODUCTION

Healthcare-associated infections (HAIs) are an important cause of morbidity and mortality among hospitalized patients. They are responsible for prolonged hospital stay, long term disability, increase in the cost of treatment, increase in the transmission of drug-resistant pathogenic organisms and more risk of deaths.¹ According to the World Health Organization, at any time of hospital stay, up to 7% of patients in developed and 10% in developing countries will acquire at least one HAI.²

There are two types of flora present on hands. Resident flora like Diptheroids is difficult to remove by hand hygiene but rarely pathogenic. Gram negative bacteria and *Staphylococcus aureus* belongs to transient flora which can be easily removed by effective routine hand hygiene. They are acquired by Health Care Workers from colonized or infected patients or from inanimate objects in the patient's immediate environment and are the organisms most frequently to cause HAIs.³

Total bacterial count on the hands of medical staff has ranged from 3.9×10^4 to 4.6×10^6 . Fingertip contamination ranged from 0 to 300 CFU when sampled by agar contact methods. Their number increases with the duration of clinical activities, on average by 16 CFU per minute. The risk of cross transmission of transient flora depends on the type of microorganism, the number of microorganisms present on the surface and the skin moisture.³⁻⁶

Hand hygiene has now been recognized as one of the most effective, simple and least expensive intervention to control the transmission of infections in a hospital as well as control of antimicrobial resistance (AMR).¹ Adequate hand hygiene among health care worker can prevent about 15% to 30% of the health care associated infections.⁷ However, compliance among HCWs has been unacceptably low due to various reasons.^{8,9}

The pioneer studies in the early 19th century done by Ignaz Semmelweis and Oliver Holmes concluded that hand hygiene is one of the most important measure for preventing transmission of pathogens in health-care facilities. WHO launched the first global patient safety challenge; Clean care is safer care in 2005 and later, "Save Lives:

Clean Your Hands" initiative for global reduction of HCAs.⁸ The proper use of hand hygiene techniques needs continuing education.¹⁰ The display of posters provided by WHO act as effective tools of education. In addition, CME programmes for all level of healthcare providers are important.¹

The study was planned with the aim to know the pattern of microbial flora and its drug resistance and effectiveness of hand hygiene in reducing this bacterial load on hands of health care workers.

MATERIAL AND METHODS

Study design and setting: This observational study was conducted in the department of Microbiology, SHKM Government Medical College; Nalhar. A total of 50 healthcare workers who consented for the study from Intensive Care Units and Medicine ward were included in the study. These were 11 doctors, 32 nurses and 7 ward boys.

INCLUSION CRITERIA: Healthcare workers without any signs of abrasions, wounds or infections on the skin of hand were included in the study.

EXCLUSION CRITERIA:

Healthcare worker who did not gave consent and individuals with skin infection.

Procedure: Each of the participants were demonstrated the correct steps of hand hygiene using alcohol based hand rub. WHO posters were displayed at the prominent sites in the hospital. Finger imprints of both the hands were taken on Blood agar before and after hand hygiene for 15 seconds with identical pressure. The culture plates were incubated for 24 hours at 37°C. Colony count was done. The percentage reduction in colony count was calculated. Bacteria were identified based on colony characteristics and standard biochemical tests. Antimicrobial susceptibility was performed on MHA by Kirby-Bauer Disc diffusion method as per CLSI 2019 guidelines.

RESULTS

A total of 50 Healthcare workers comprising of 11 doctors, 32 nurses and 7 ward boys participated in the study. Culture on blood agar was positive for bacterial growth in all the fifty samples (100%) before

performing hand hygiene. Among these thirty-seven samples (74%) showed colony count >100 and thirteen samples (26%) showed colony count <100. After performing hand hygiene, 1-10 CFU on blood agar were observed in thirty nine (78%) and >10 in 11 samples (22%).

The cultures taken before performing hand hygiene showed mixed growth in ten samples. Micrococcus was most common organism isolated in twenty-four samples, followed by diptheroids in sixteen samples, Coagulase negative staphylococcus in fourteen samples and *Staphylococcus aureus* in six samples. Three CoNS and four *Staphylococcus aureus* were Methicillin resistant. Gram negative bacilli isolated were *Klebsiella* species, *Pseudomonas* species and *Escherichia Coli* each in two samples respectively. One *Escherichia Coli* was ESBL producer. All the GNB were sensitive to carbapenem.

After performing hand hygiene micrococcus was isolated from four sample, diptheroids from three and CONS from one sample. *Staphylococcus aureus* and GNB were not found after hand hygiene.

Figure 1 - Total number of health-care workers

Figure 2 -Bacterial growth before and after Hand hygiene

Table 1 - Bacterial load observed among HCWs before Hand Hygiene

HCWs	Colony Count >100	Colony Count <100	Total
Doctors	7	4	11
Nurses	23	9	32
Ward Attendants	7	0	7
Total	37	13	50

Table 2 - Bacterial load observed among HCWs after Hand Hygiene

HCWs	Colony Count	
	<10	>10
Doctors	11	0
Nurses	26	6
Ward Attendants	2	5
Total	39	11

Table 3 - Percentage reduction in colony count seen among HCWs after Hand hygiene

HCWs	90-99%	< 90%
Doctors	11	0
Nurses	26	6
Ward Attendants	2	5
Total	39	11

Table 4 – Organisms isolated and their antibiotic resistance

Organism isolated	Before HH (n)	After HH (n)	Drug resistance detected
Micrococcus	24	4	
Diphtheroids	16	3	
Coagulase negative Staphylococcus (CoNS)	14	1	Methicillin Resistant CoNS (3)
<i>Staphylococcus aureus</i>	6	0	Methicillin Resistant <i>Staphylococcus aureus</i> (4)
Enterobacteriaceae	4	0	
<i>Klebsiella Pneumoniae</i> (2)		0	ESBL Producer (1)
<i>Escherichia Coli</i> (2)		0	
Nonfermenter GNB	2	0	ESBL Producer =None
<i>Pseudomonas aeruginosa</i> (2)			Carbapenem Resistant=None

ESBL=Extended Spectrum Beta-lactamase, GNB=Gram negative Bacilli

Figure 3- Organisms isolated from the finger tips of HCW

DISCUSSION

According to WHO five moments of Hand Hygiene are before touching a patient, before clean/aseptic procedures, after body fluid exposure, after touching the patient and after touching patient surroundings.⁸

The available methods of hand hygiene are soap and water, alcohol-based hand rubs and chlorhexidine-based hand rubs. The advantage of chlorhexidine is the residual activity but it is expensive. Soap and water are economical but need for safe running water and a sterile towel to dry hands is a limitation. In a busy hospital alcohol-based hand rubs may help in improving compliance and also maybe cost-effective.⁹

In the present study micrococcus was the most common organism isolated from the hands of HCW both before and after hand hygiene. Bhatia S and Dehankar U found hand contamination to be maximum with Coagulase-negative staphylococci (CoNS) in both before and after hand hygiene procedures.¹¹

It was observed in this study that 26(52%) of the HCW carried pathogens on their hand. Coagulase negative staphylococci (CoNS) was 14(21%), *Staphylococcus aureus* was 6 (9%), *Klebsiella Pneumoniae*, *Escherichia coli* and *Pseudomonas aeruginosa* were 2 (3%) respectively.

Kapil et al found in their study that 35% of the HCW carried pathogens on the hand. In their study *Staphylococcus aureus* was isolated from eight samples, *Acinetobacter* in eight samples, *Enterobacteriaceae* in 5 samples.¹

Singh S et al found in their study that the bacterium most commonly isolated was *Staphylococcus aureus* (47.5%). Coagulase negative staphylococcus (CoNS), a resident flora was obtained in 37% of HCW. Among Gram – negative bacilli, *Acinetobacter* species followed by *Klebsiella species* and *Escherichia coli* were isolated.¹²

Abaza et al in their study reported colonization with CoNS in 80% HCW. Regarding transient flora, *Staphylococcus aureus* and GNB colonization rate was 8% and 9% respectively.¹³

J.C. Lucet et al in their study observed that before hand hygiene, 95.4% bacteria isolated from culture were skin commensals such as *Corynebacterium* species, *Coagulase negative staphylococci*, *Micrococcus* or *Bacillus* species. Transient flora constituted only 4.6% of culture-positive specimens before hand hygiene which included three *Staphylococcus aureus*, two *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, *Enterococci* and fungi respectively.¹⁴ Pittet et al also found *Staphylococcus aureus* (10.5%) and gram-negative bacilli (14.5%) whereas rest (75%) was skin commensals in their study.⁶

In our study percentage reduction in bacterial load after hand hygiene in majority that is 39 participants was 90-100% and in 11 participants it was < 90%. Kapil et al observed 95-99% reduction in the bacterial load in majority after hand hygiene. Singh S et al also found 95-99% reduction in bacterial load after proper hand hygiene. Abaza et al in their study showed that median percentage reductions in bacterial load were 87%-99% with alcohol based hand rubs and 30% with soap and water.⁹ Bhatia S and Dehankar U reported 83.4% reduction in bacterial load after hand hygiene with alcohol-based hand rub, 16.7% with medicated soap and 6.7% for unmedicated soap respectively.^{1,11-13}

In the present study after hand hygiene Micrococcus was isolated from

4, Diptheroids from 3 and CoNS from 1 specimen respectively. All these are resident flora. No transient flora was isolated after hand hygiene which underlines the fact that hand hygiene efficiently removes the pathogenic organisms. Kapil et al also reported absence of transient flora post hand hygiene. Singh S et al observed growth of one MRSA after hand hygiene. We did not observe any such finding. J.C. Lucet et al found transient flora only in two cases after hand hygiene with unmedicated soap.^{1,12,14}

Among Staphylococci, 3 out of 14 (21.4%) CoNS and 4 out of 6 (66.6%) *Staphylococcus aureus* were Methicillin resistant. In *Enterobacteriaceae*, one out of four (25%) were ESBL producers and all were sensitive to carbapenem. The two nonfermenters, *Pseudomonas aeruginosa* isolated were non ESBL producers and carbapenem sensitive. Kapil et al in their study found that 3/5 (60%) of *Enterobacteriaceae* were ESBL producers and 3/8 (37.5%) showed resistance to carbapenem. Singh S et al reported 50/95 (52.6%) of *Staphylococcus aureus* to be Methicillin resistant.^{1,12}

The advantages of fingertip imprint method is its simplicity, easy to use in clinical set up and give good results when evaluating transient flora and their reduction by routine hand hygiene performance. However the results may not be accurate as samples are not taken from different parts of the hand.

CONCLUSION

Hands of the HCWs if colonized with bacterial flora can transmit it to the patients. The risk is significant among immunocompromised and in critical care settings. Various studies have shown that compliance of Hand hygiene practice was less than 50% and it differed among different professional categories of HCW. Therefore effective hand hygiene practice and its monitoring will significantly decrease the rates of HAI especially in low and middle income countries.

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