ORIGINAL ARTICLE e-ISSN: 2349-0659 p-ISSN; 2350-0964

A Study of Microbial Load on the Hands of Nursing Staff in Tertiary Care Hospital

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Abstract

Background: Infections due to hospital-acquired microbes is an evolving problem worldwide. Prevalence as high as 19%, of these infections in developing countries poses a challenge to health-care providers. A major source of horizontal transmission of the nosocomial infections are thought to be bacterial contamination of palm of hand of health care providers such as doctors and nurses. Hand hygiene is the single most cost effective preventive measure against hospital acquired infections and education is an important tool to ensure its implementation. **Aim:** The present study was undertaken, to demonstrate the presence of resident microbial flora on the hands of nursing staff after duty hours working at various critical areas in a tertiary care hospital with their antibiogram. **Materials and Methods:** This cross-sectional analytical study was carried out after ethical clearance from June to August 2020 on 100 nursing staff of either sex working in critical areas of tertiary care hospital after due informed consent from the nurses. A sterile swab moistened with sterile normal saline was used to collect the swabs from dominant (working) hands after working hours. The collected swabs were processed for isolation, identification, and antibiotic sensitivity of organisms. **Results:** Out of 100 swabs collected from the dominant hands of nurses working in critical areas, 83 showed the growth. All the samples cultured shows growth of more than two organisms. The major Gram-positive pathogenic organisms grown were Coagulase negative *Staphylococcus* spp. Forty (48.19%) followed by *Staphylococcus aureus* 30 (36.14%) whereas among Gram-negative *Klebsiella* spp. five (6.025%) and *Pseudomonas aeruginosa* four (4.81%) predominated. **Conclusions:** In the present study, the level of contamination of nursing staff was found to be high. Resident flora consisting of multi drug resistant pathogenic organisms can be greatly reduced by an increase in hand-hygiene awareness coupled with organizational interventions. We recommend to closely monitoring hand hygiene practices for effective intervention strategies.

Keywords: Dominant hands, Hospital-acquired infections, Multidrug resistant organisms, Nursing staff, Resident microbial flora

Asian Pac. J. Health Sci., (2021); DOI: 10.21276/apjhs.2021.8.1.18

Introduction

Infections due to hospital-acquired microbes are an evolving problem worldwide. The high prevalence up to 19% in developing countries poses a challenge to health-care providers.[1]

A major source of horizontal transmission of the nosocomial infections are thought to be bacterial contamination of palm of hand of health-care providers such as doctors and nurses. The concept of cleansing hands with any antiseptic agent to prevent these infections evolved in the early 19th century.[2] Semmelweis and Holmes emphasized the importance of meticulous hand washing to prevent cross-transmission and nosocomial transmission of pathogenic bacteria. As key players in the health-care team, a study of microbial flora on hands of nursing staff is of utmost relevance.

Hand hygiene is considered the single most cost-effective preventive measure against hospital-acquired infections (HAI), and can contribute to shorter hospital stay, reduction in patient morbidity and health-care costs.[3] Education regarding hand hygiene is an important tool to ensure its implementation. Failure to apply hand hygiene creates a huge reservoir of pathogenic drug resistant bacteria that can cross-infect the next patient.

Knowledge of the resident and transient bacterial flora, importance and implementation of hand hygiene among health-care professionals in containment of HAI is important but regular education and monitoring of the same is need of the hour which is lacking in most hospital setting.[4] Keeping this in view, the present study was undertaken to find out the resident microbial flora on the hands of nursing staff working at various locations of tertiary care hospital with their antibiogram.

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How to cite this article: Kumar D, Bimal KK, Archana, Singh SN. A Study of Microbial Load on the Hands of Nursing Staff in Tertiary Care Hospital. Asian Pac. J. Health Sci., 2021; 8(1):87-89.

Source of support: Nil

Conflicts of interest: None.

Received: 11/11/2020 **Revised:** 17/12/2020 **Accepted:** 20/01/2021

Materials and Methods

This study was conducted in the Department of Microbiology, at Patna Medical College and Hospital, Patna. Ethical clearance was obtained from the institutional ethical and research committee.

Table 1: Number of samples and culture growth from staff nurses of different areas of tertiary care hospital

Working hospital area of staff nurse	*Number of samples collected*	*Samples showing growth of pathogenic organisms (%)*
NICU	15	12 (80.00)
MICU	16	13 (81.25)
SICU	16	13 (81.25)
Burn Unit	7	6 (85.71)
Casualty	15	13 (86.66)
Major OT	25	21 (84.00)
Minor OT	6	5 (83.33)

NICU: Neonatal intensive care unit; MICU: Medical intensive care unit; SICU: Surgical intensive care unit; OT: Occupational therapy

Table 2: Pathogenic organisms isolated from dominant hands of nursing staff working in different areas of tertiary care hospital

Area	*NICU*	*MICU*	*SICU*	*Burn unit*	*Casualty*	*Major OT*	*Minor OT*	*Total*
CONS	6	6	5	1	8	12	2	40
S. aureus	4	5	4	2	5	7	3	30
Klebsiella spp.	2	1	2	0	0	0	0	5
P. aeruginosa	0	1	0	3	0	0	0	4
Citrobacter spp.	0	0	1	0	0	1	0	2
Acinetobacter spp.	0	0	0	0	1	0	0	1
E. coli	0	0	1	0	0	0	0	1
Total								83

CONS: Coagulase-negative *Staphylococcus*; NICU: Neonatal intensive care unit; MICU: Medical intensive care unit; SICU: Surgical intensive care unit; OT: Occupational therapy; *E. coli: Escherichia coli; P. aeruginosa: Pseudomonas aeruginosa; S. aureus: Staphylococcus aureus*

This cross-sectional analytical study was carried out from June to August 2020 on nursing staff of our institution. After obtaining the institutional ethics clearance, 100 staff nurses of either sex working in critical areas of tertiary care hospital such as intensive care unit (ICU), medical ICU (MICU), surgical ICU (SICU), BURN Wards, Casualty, and Major and Minor occupational therapy (OT's) were included in the study and informed written consent was taken from the nurses.

Samples were collected after the duty hours of the nursing staff using sterile cotton swabs (moistened with sterile normal saline) by rotating the swabs on the dominant (working) hands beginning from the flexor aspect of the wrist, across the palm and up all the five fingers (beginning with thumb) including the creases, web spaces and nail beds, and ending in the dorsal aspect of the palm. Sample was collected by gently rolling the swab stick over the areas for 15–20 s. Samples were transported immediately to the microbiology laboratory and processed using standard microbiological techniques for culture and identification of organism based on various biochemical tests.[5] The antibiotic sensitivity testing of the isolated organisms was done by Kirby–Bauer's disk diffusion according to Clinical and Laboratory Standards Institute (CLSI) guidelines.[6]

Results

Of the 100 dominant (working) hands of nurses working in the different areas of the hospital, majority 47 were from the nurses working in the ICU (medical, neonatal, and surgical). Twenty-five swabs were collected from the nurses working in major OT's, 15 swabs from the casualty and seven and six from the nurses working in the burn unit and Minor OT, respectively [Table 1].

Around 83 samples collected have shown growth after culture.

All the samples showed the presence of two or more type of organisms. The major contaminant nonpathogenic bacterium isolated from the nurses hands were diphtheroids and aerobic spore bearing bacilli, that is, 50 (50%).

The major Gram-positive pathogenic organisms grown were Coagulase negative *Staphylococcus* (CONS) 40 (48.19%), followed by *Staphylococcus aureus* 30 (36.14%). The major Gram-negative bacilli isolated in order of frequency were *Klebsiella* spp. five (6.025%), *Pseudomonas aeruginosa* 4(4.81%), *Citrobacter* spp. 2(2.40%), *Acinetobacter* spp. 1 (1.20%), and *Escherichia coli* 1 (1.20%) [Table 2].

Eight (26.66 %) isolates of *S. aureus* were found to be Methicillin-resistant *S. aureus* (MRSA) whereas nine (22.5%) strains of CONS were MRSA [Table 3] based on the Cefoxitin resistance as per CLSI guidelines.

Table 3: Sensitivity pattern of Gram-positive organisms isolated among the nursing staff working in different areas of tertiary care hospital

Drug tested	*Name of the organism*	
Drugs	*S. aureus (n=30) Number Sensitive (%)*	*CONS (n=40) Number Sensitive (%)*
Amikacin	22 (73.33)	28 (70.00)
Chloramphenicol	24 (80.00)	24 (60.00)
Clindamycin	23 (76.66)	27 (67.5)
Co-trimoxazole	12 (40.00)	19 (47.5)
Cefoxitin	22 (73.33)	31 (77.5)
Erythromycin	16 (53.33)	26 (65.00)
Gentamycin	17 (56.66)	22 (55.00)
Levofloxacin	15 (50.00)	23 (57.5)
Linezolid	30 (100.00)	40 (100.00)
Penicillin	03 (10.00)	12 (30.00)
Vancomycin	30 (100.00)	40 (100.00)

Number sensitive (%) = Number of organisms sensitive (Percentage of organisms sensitive); CONS: Coagulase-negative *Staphylococcus; S. aureus*: *Staphylococcus aureus*

Hands of nurses working in critical areas of hospital, that is, ICU, MICU, SICU, Burn, and O.T's showed maximum contamination. Hand contamination rates were uniform despite increase in working experience, and failed to show significant improvement even after attending training sessions.

Discussion

The World Health Organization promotes measures to improve hand hygiene which is one of the five foremost goals of its current worldwide Patient Safety Program with its First Global Patient Safety Challenge "Clean care is Safer care", launched in 2005 and dedicated to the prevention of HAI. The human skin is constantly and continuously bombarded by organisms present in the environment. Transient microflora tends to occur more frequently on the skin. The human skin is home to about 10 microbes.[5]

Gram-positive bacteria predominate over Gram-negative bacteria. The bacteria more commonly recovered from skin surfaces are *Staphylococcus* spp., *Micrococcus* spp., *Corynebacterium* spp., *Peptostreptococcus,* and *Propionibacterium* spp. *Staphylococcus epidermidis* is the most commonly isolated bacterium. Washing reduces the transient flora (contaminating flora) by about 2–3 log levels. Pioneering works of Semmelweis and Florence Nightingale showed that with proper sanitation and hand washing with general cleanliness of healthcare workers such as doctors and nurses could prevent HAI.[6]

In our study, the dominant hands of nurses demonstrated a higher contamination rate (80%) with bacteria including nosocomial pathogens. The rate of contamination was 83% which

Table 4: Sensitivity pattern of Gram-negative organisms isolated among the nursing staff working in different areas of tertiary care hospital

Antibiotic Used	*Klebsiella spp. (n=5) (%)*	*P. aeruginosa (n=4) (%)*	*Citrobacter spp. (n=2) (%)*	*Acinetobacter spp. (n=1) (%)*	*E. coli (n=1) (%)*
Amikacin	3 (60)	3 (75)	2 (100)	1 (100)	1 (100)
Amoxycillin+Clavulanic acid	2 (40&)	1 (25)	0 (0)	0 (0)	0 (0)
Cefepime	2 (40&)	2 (50)	1 (50)	0 (0)	1 (100)
Ceftazidime	2 (40&)	2 (50)	1 (50)	0 (0)	1 (100)
Ceftriaxone	2 (40&)	0 (0)	1 (50)	0 (0)	0 (0)
Ciprofloxacin	1 (20)	1 (25)	0 (0)	0 (0)	0 (0)
Colistin	5 (100)	4 (100)	2 (100)	1 (100)	1 (100)
Co-trimoxazole	1 (20)	1 (25)	0 (0)	0 (0)	0 (0)
Imipenem	4 (80)	3 (75)	2 (100)	1 (100)	0 (0)
Levofloxacin	1 (20)	1 (25)	1 (50)	0 (0)	0 (0)
Meropenem	3 (60)	3 (75)	2 (100)	1 (100)	1 (100)
Piperacillin/Tazobactam	3 (60)	3 (75)	2 (100)	1 (100)	1 (100)

E. coli: Escherichia coli; P. aeruginosa: Pseudomonas aeruginosa

is higher when compared to the study[7] conducted in Bengaluru, where the contamination rates were 61%. Barriers to practice hand hygiene was attributed to lack of education, high work load, understaffing, working in critical care units, lack of encouragement, and lack of role model among senior staff.

The pattern of bacterial isolates was dominated by CONS 40/83 (48.19%), followed by *S. aureus* with 30/83 isolates (36.14%) of which 8 (26.66%) were MRSA. Amongst Gram-negative isolates *Klebsiella* spp.5/83 (6.02%) and *P. aeruginosa* 4/83 (4.81%) predominated. The important aspect to observe is that strains are still sensitive to higher drugs [Tables 3 and 4].

In their study Bhavsar *et al*. from Gujarat, India, showed similar higher rate of bacterial colonization of hands of healthcare workers, predominantly by *S. aureus*, much like our findings.[8] William *et al*. in their study isolated *Acinetobacter*, *Klebsiella*, *Pseudomonas*, *E. coli*, and *Proteus* spp. from the hands of nurses where the most common organism reported was *S. aureus* seen in 44% samples. These findings are also in consonance with our study.[9]

Majority of the Gram-negative isolates have shown resistance to commonly used drugs such as Amoxycillin+Clavulanic acid, cephalosporins, fluoroquinolones, as well as to higher antibiotics such as Meropenems and Piperacillin/Tazobactam.[10] In the present study, 55.60% resistance was noted to cephalosporins, similar results were observed in a study by Hena *et al*.[11]

Fluoroquinolones were sensitive in 50% in *Citrobacter* sp, 25% in *Pseudomonas* sp, and 20% in *Klebsiella* sp. This finding is consistent with a study done by Sankarankutty *et al*.[10] High sensitivity was noted to Carbapenam and Piperacillin tazobactam in the present study. This finding was supported in a study done by Balan *et al*.[12] [Table 4].

The presence of MRSA strains and strains which are showing multidrug resistance to commonly used antibiotic on the hands of nursing staff after their duty hours pose a great risk of transmission of the pathogenic resistant strains from these health-care providers to other areas posing potential vectors in HAI and a hindrance in containment of the HAI.

Conclusions

In the present study, highlights the level of contamination by pathogenic multidrug-resistant organisms on the dominant hands of nursing staff working in critical areas of the tertiary care hospital. These resident floras pose a great risk for HAI as a potential source of infection. This resident flora can be greatly reduced by an increase in hand- hygiene awareness coupled with organizational interventions. Practicing proper hand hygiene techniques to reduce the colonization of pathogenic bacteria on hands of health-care providers is must for containment of HAI. We recommend to regularly monitoring hand hygiene practices for effective intervention strategies. Further large scale studies are required to address these kind of issues.

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