Bacterial contamination of health care worker's hands in intensive care units in Rasht

AliMojtahedi¹, Hossein Khoshrang²*, Mortteza Rahbar Taromsari³, Ehsan KazemnezhadLeili⁴, Ebrahim Hoovash⁵

ABSTRACT

Introduction and Objective: Nosocomial infection, especially in the ICU, is a serious health center problem that causes the spread of disease in the community, and contributes to increased medical costs and mortality rates. The aim of this study was to find the relative frequency of microbial contamination on the hands of ICU staffs in educational and remedial centers in Rasht, North of Iran.

Methods: This cross-sectional study included all ICU staffs in remedial hospitals in Rasht. The samples were obtained using sterile swabs from the staffs’ hands in different working shifts and these were sent to a central referral laboratory. Finally, the data were analyzed using SPSS software (version16), Pearson’s chi-square and Fisher’s exact test.

Results: Out of 106 subjects, 90 (84.91%) were female and 16 (15.09%) were male. Of the 106 cultures, 91 (85.9%) were positive and 15 (14.1%) were negative. Coagulase negative Staphylococci (CNS) were the most common resident flora (52.27%) found in the contaminated samples. Pseudomonas was the most common transient flora (73%) on personnel’s hands. Staphylococcus aureus was the most common infectious flora isolated. There were no significant relations between microbial contamination and gender, different ICUs, job positions or work experience.

Conclusion: Regarding high microbial contamination on the hands of ICU staffs in our investigation, hand washing is considered to be one of the easiest and most cost-effective measures to prevent nosocomial infection.

Keywords: Infection transmission, Intensive care units, Nosocomial infection

Introduction

Nosocomial infection is a serious problem in health-care centers, occurring in approximately 10% of admissions in developed countries and 25% in developing countries. Nosocomial infections occur most frequently in the intensive care unit (ICU). From 5% to 10% of patients admitted to acute care hospitals acquire one or more infections, and the risks have steadily increased during recent decades. Nosocomial infections among ICU patients are usually related to the use of immunosuppressant
drugs or invasive devices (e.g., mechanical ventilators, urinary catheters, or central venous catheters)(1, 2). Health care workers’ (HCWs) hands are the most common vehicle for the transmission of healthcare-associated pathogens, both from patient to patient, and within the healthcare environment. Hand hygiene is the leading measure for preventing the spread of antimicrobial resistance and reducing healthcare-associated infections (HCAIs); however, HCWs compliance with optimal practices remains low in most settings(3).

Normal human skin harbors bacteria, usually between $10^2$ and $10^6$cfu/cm²(4). During daily activities, HCWs progressively accumulate microorganisms on their hands from direct patient contact, respiratory tract care, contact with body fluids, and after being interrupted while caring for a patient(5, 6). Skin flora, for example Staphylococci and also gram-negative bacilli, can be transmitted in this way. Therefore, hand hygiene often prevents the transmission of microorganisms (2). Studies have shown that one out of five hospital staff members has antibiotic resistant pathogens on his/her hands (7, 8). Despite the importance of proper hand washing in reducing the transmission of pathogens to patients and the spread of antimicrobial resistance, the inclination of HCWs to comply with recommended hand-hygiene practices has remained unacceptably low (9, 10).

Hand microorganisms have been divided into three groups; resident, transient and infectious organisms(11,12). Resident flora includes organisms with low pathogenicity such as; coagulase Negative Staphylococci (CNS), Micrococcus and lipophilic Corynebacterium. Hand washing does not change their number to any considerable extent, but they are seldom transmitted to patients unless via invasive procedures. Transient flora is the most important cause of nosocomial infections which is acquired primarily via contact of patients with peripheral surfaces, although it does not proliferate on the skin and can easily be washed. Pseudomonas and Escherichia coli are examples of transient microorganisms. Hand washing with soap and water for 8-20 seconds reduces 90% of transient microorganisms. Infectious floras can be found in skin lesions until improvement of the condition. Staphylococcus aureus and β-hemolytic Streptococci are infectious organisms (11, 12). Hand washing is the most cost effective, comfortable and easy way to prevent hospital infections, but HCWs consistently fail to perform this simple and inexpensive procedure, thereby compromising patient safety and the quality of medical care (10). Because of the importance of nosocomial infection and the role of HCWs’ hands in the transmission of infection and the high incidence of infection in the ICU, the aim of the present study was to determine the relative frequency of microbial contamination on the hands of ICU staffs in educational and remedial centers in Rasht, North of Iran.

**Materials and methods**

In a cross-sectional study, all ICU workers who participated in patient care during the day shift at Poursina, Razi, Heshmat and Al-Zahra hospitals of Guilan University of Medical Sciences, Rasht, Iran, were included. Personal data from ICU staff members such as; gender, age, job position, work experience and type of ICU, were collected. After obtaining informed consent, samples of staffs’ hands in different work
shifts were cultured by sterile swabs once per day. The swabs were embedded into vials containing Stuart medium. Then the vials were sent to central referral laboratory for the culture and identification of bacteria. Swabs were cultivated on blood agar and eosin methylene blue agar and incubated at 37°C for 24 h. Finally, Gram staining and standard microbiologic procedures using differential culture media were performed to identify bacterial colonies. In addition, the number of colonies per plate was counted. No anaerobic cultures were performed.

**Statistical analysis**

All demographic data of HCWs including; gender, age, job positions, work experience, type of ICU, and data obtained from cultivating the samples, were analyzed using Pearson’s chi-square and Fisher's exact tests.

**Results**

Out of 106 subjects, 90 (84.91%) were female and 16 (15.09%) were male. Nurses with 81 (76.42%) cases were the largest group studied. Out of 106 samples, 91 (85.90%) had positive and 15 (14.1%) negative growth. Resident flora was found on 44 (41.51%) hands of HCWs. In this group, CNS in 23 (21.70%) cases and Micrococcus in 10 (9.43%) cases was the most common resident flora isolated from the staff's hands, respectively. Transient flora was isolated from 63 (59.43%) cases. Pseudomonas with 46 (43.39%) cases was the most common isolated transient flora. Moreover, infectious flora was found in 5 (4.72%) cases of staff hands, Staphylococcus aureus was isolated in 4 cases, and β-hemolytic Streptococci in 1 case (Table 1).

**Table 1. Microbial flora isolated from staff’s hands**

<table>
<thead>
<tr>
<th>Resident flora</th>
<th>Number isolated</th>
<th>Percent</th>
<th>Transient flora</th>
<th>Number isolated</th>
<th>Percent</th>
<th>Infectious flora</th>
<th>Number isolated</th>
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<tbody>
<tr>
<td>CNS</td>
<td>23</td>
<td>21.70</td>
<td>Pseudomonas</td>
<td>46</td>
<td>43.39</td>
<td>Staphylococcus aureus</td>
<td>4</td>
<td>3.78</td>
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<td>Micrococcus</td>
<td>10</td>
<td>9.43</td>
<td>EScherichia coli</td>
<td>7</td>
<td>6.6</td>
<td>β-hemolytic Streptococci</td>
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<td>Corynebacterium</td>
<td>1</td>
<td>0.94</td>
<td>Pseudomonas + Escherichia coli</td>
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<td>Others</td>
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CNS: Coagulase Negative *Staphylococci*

*Pseudomonas, Staphylococcus epidermidis* and *Micrococcus* were the most common isolated organisms from the ICU staffs’ hands.

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Contamination with resident flora in males and females was 37.5% and 42.2%, respectively. According to a Fisher's exact test, there was no significant relationship between the type and number of resident flora and gender (P< 0.724). Contamination with transient flora in males (62.5%) was higher than in females (58.9%). Fishers’ exact test revealed no significant relationship between transient flora and gender (P< 0.524).

Contamination with infectious flora in males was greater than in females, 6.25% and 4.4% respectively, but this discrepancy was not statistically significant (P<0.566). CNS and Micrococcus with 8 and 4 cases, respectively, was the most isolated resident flora in the general ICU. Corynebacterium with 1 case was the most common resident flora isolated in the cardiology ICU (Fig. 1). There was no significant relationship between resident flora and type of ICU (P> 0.06).

Contamination with transient flora was different in the various ICUs and most cases of Pseudomonas isolates were found in the general ICU (12 cases), while two cases of Enterobacter were isolated in pediatrics and cardiology ICUs (Fig. 2). There was no significant association between transient flora and type of ICU (P> 0.087).

As shown in Fig. 3, in terms of contamination with infectious flora, the neurosurgery ICU had the highest number of cases of contamination with Staphylococcus aureus (2 cases), and the general ICU had the most cases of contamination with β-hemolytic Streptococci (1 case). There was no significant relation between infectious flora and type of ICU (P> 0.81).

Personnel with 6-10 and more than 20 years of experience had the most contamination with resident flora. Furthermore, personnel with 1-5 years of experience had the greatest contamination with transient flora. Finally, contamination with infectious flora was observed more frequently in personnel with 16-20 years of experience.

Figure 1. Contamination of staff’s hands with resident flora in different ICUs

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Contamination with three different flora based on the job position of the ICU staff member revealed that hygienists had the most cases of contamination with resident flora, but in terms of transient flora, other jobs had the highest contamination levels. Moreover, servants had the highest contamination with infectious flora. Briefly, there was no significant relationship between microbial contamination and gender, job position, work experience or type of ICU (P<0.402).

Figure 2. Contamination of staff’s hands with transient flora in different ICUs

Figure 3. Contamination of staff’s hands with infectious flora in different ICUs
Discussion

In several previous studies, the most common route of infection transmission in patients and in different hospital wards were the contaminated hands of nurses, technicians, and other people dealing with patients (3, 12, 13). In the present study, we examined microbial contamination of staff's hands working in the ICUs of hospitals in Rasht, Iran. All HCWs in the different ICU units such as; internal, neurosurgery, cardiology, pediatrics, general, and gynecology were included. Our results showed that there was a high rate of microbial contamination on the staffs' hands (85.9%), and among the isolated floras, transient flora was the most common flora isolated.

In a study by Khalifeh Soltani et al. in 2003, the most common organisms isolated from hospital personnel's hands were coagulase negative Staphylococci (72.9%), Staphylococcus aureus (30.5%), Bacillus (22%), Klebsiella (10.2%), Streptococci (3.4%), and Escherichia coli (1.7%), respectively (13).

In the present study, the most common isolated organisms were Pseudomonas (50%) and CNS (29.25%), respectively. Our results were not consistent with those of the Khalifeh Soltani's study. The study of Khodadad A., et al. in 2004 in Tehran, Iran, showed that the most common isolated organisms from staff's hands was coagulase negative Staphylococci (79.4%) (14).

In another study in 2004, Zobeiri et al. showed that 88.03% of samples had contamination with transient flora 12, which was higher than our results (59.43% for transient flora).

The study of Pittet et al. in 1999, revealed that 327 (78.4%) samples out of 417 samples obtained from personnel's hands had positive cultures, in which 75% were resident flora, 14.5% transient and 10.5% infectious flora (5). Khodavaisyet al. in 2011 studied on 40 HCWs in one hospital. Their results showed that the rate of contamination of hands and rings was 73.1%. Most of the isolates known to cause nosocomial infections were: Staphylococci (23%), Klebsiella spp. (7.9%), Enterobacter spp. (4.7%), Escherichia coli (3.9%), Acinetobacter spp. (3.1%), and Pseudomonas spp. (2.3%) 15. Our findings showed a majority of Pseudomonas with 50% which was higher than their study's results.

Education is the most effective policy in preventing nosocomial infection and only continuous education can reduce infectious cases. Hand washing with water and soap is effective in the control of up to 50% of nosocomial infections. Although hand washing is the most important, cost effective and easiest way to prevent nosocomial infection, inadequate attention has been paid to remedial hospital personnel, and unfortunately, the quality of hand washing remains low (10). The reasons for poor hand-hygiene practices include; lack of scientific knowledge, lack of risk awareness, misconceptions (e.g., glove use obviates the need for hand hygiene), unavailability of hand-hygiene facilities (sinks or alcohol dispensers), lack of role models among colleagues or superiors, understaffing or patient overcrowding, and lack of institutional priority (10).

Manfred LR et al. in 2007 showed that in spite of the fact that HCWs have been advised to regularly use gloves and hand washing, less than 50% of ICU staff did not use these prevention methods (16). The study of Fridkin et al. in 1997, in the Northern United States showed that hand contamination with any transient...
organism was significantly less likely after the use of an alcohol-based hand rub, compared with the use of plain soap and water (17).

Furthermore, Girouet et al. showed that routine patient hand care, rubbing with an alcohol-based solution, is significantly more efficient in reducing hand contamination than washing with antiseptic soap (18).

In another study, William et al. showed that wearing rings was associated with 10-fold higher median skin organism counts; contamination with Staphylococcus aureus, gram-negative bacilli, or Candida species; and a stepwise increased risk of contamination with any transient organism, as the number of rings worn increased. They concluded that ring wearing increased the frequency of hand contamination with potential nosocomial pathogens. Use of an alcohol-based hand rub resulted in significantly less frequent hand contamination (19).

Gloving is recommended as a barrier in protecting HCWs as it reduces the risk of contamination during contact with body fluids, mucous membranes or patients’ skin injuries (20, 21). Recently, the Health Care Infection Control Practices Advisory Committee of the Centers for Disease Control and Prevention released new hand hygiene guidelines that promoted increased use of alcohol-based hand rubs (22).

In conclusion, HCWs must follow careful hand washing techniques to minimize the transmission of disease and they should remove rings, watches, and bracelets before washing their hands and entering the ICU. Moreover, hospital administrators should strive to create an organizational atmosphere in which adherence to recommended hand hygiene practices is considered an integral part of providing high-quality care.

Acknowledgement

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References

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