

Surveillance of bacterial carriage in the nose and hands of healthcare workers and patients attending maternity and children's hospital

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ABSTRACT

Introduction: Nosocomial infections have been acknowledged as a significant pathogen responsible for human illness due to the rise in the incidence of these infections that are mainly caused by resistant strains. As a result, it is important to prevent nosocomial infections. Therefore, in the epidemiology and pathogenesis of infection bacterial carriage appears to be of great importance and in healthy persons, three patterns of carriage are observed over time. The common ecological niches of microorganisms are the anterior nares and hands; hence, the present study aims to evaluate the surveillance of bacterial carriage from the hands and noses of healthcare workers that involve doctors, nurses, and housekeeping staffs and patients involving pregnant women or mothers. **Materials and Methods:** An observational prospective study was conducted for 1.5 years in which collection of swabs from both the hands and nose were taken and inoculated on mannitol salt agar, blood agar, and MacConkey agar and incubated at 37°C for 24 h following which biochemical reactions were performed from isolates and 160 nasal swabs and hand swabs were studied for bacterial growth. **Results:** The percentages of bacterial growth in the hands of mothers, doctors, housekeeping staff, and nurses were 17.5, 12.5, 52.5, and 25%, respectively, and in the nose were 7.5, 5, 32.5, and 12.5%, respectively. Total bacterial carriage in hand and nose swabs were 26.87 and 14.37%, respectively. **Conclusion:** Methicillin-resistant *Staphylococcus aureus* was the most common microorganism isolated and as a result to prevent its spread along with other nosocomial microorganisms, appropriate precautions should be taken as the spreading of these organisms can lead to drug resistance strains.

Key words: Bacterial carriage, hospital-acquired infection, methicillin-resistant *staphylococcus aureus*, nasal and hand swabs, surveillance

Introduction

Nosocomial infections, also known as hospital-acquired infections or health-care-associated infections (HAIs), affect 5–10 out of every 100 hospital admissions.^[1] According to some research, nosocomial infections are typically transmitted from

hospital wards to previously uninfected patients by contact with infected patients, common inanimate sources, or carriers. The hands of healthcare professionals are the most typical method of transmission. The hands cannot be entirely sterilized, and the most efficient disinfectants for inanimate items are typically too toxic to be applied to the skin. In addition, the skin's microbial flora is unique and more challenging to eradicate than the microorganisms found on inanimate items. Gram-negative bacteria are frequently more prevalent on the skin, particularly in humid environments, and some of them, namely *Klebsiella*, *Enterobacter*, and *Acinetobacter*, can live for extended periods

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of time.^[2] The most morbidity and mortality are caused by *Staphylococcus aureus*, *Haemophilus influenzae*, *Moraxella catarrhalis*, and *Streptococcus pneumonia* in infants and the elderly, making the nasal passages an essential habitat for these pathobionts.^[3,4]

There is a higher chance of infection in those who get inpatient skin-to-skin contact, share supplies or equipment with patients who are undergoing non-intact skin medical care, undergo surgery, or have medical devices implanted in their bodies.^[5,6] It is widely acknowledged that methicillin-resistant *S. aureus* (MRSA) is spread mostly through the hands of healthcare workers. This study intends to examine bacterial carriage in healthcare workers and patients in a maternity and children’s hospital because the failure to recognize the reservoir of healthcare workers may result in invisible vectors and as healthcare workers have been frequently infected without their knowledge, the prevalence result will help the primary care physicians to take appropriate and adequate precautions.^[7-9]

Materials and Methods

An observational prospective study was conducted in the tertiary care hospital, for a duration of 1.5 years after approval from Institutional Ethical Committee (IEC) with IEC reference number N-EC/2021/SC/01/02. Nasal and Hand swabs were taken from 160 Healthcare Workers (HCWs), including 40 doctors, 40 nurses, 40 housekeeping staff, and 40 patients involving pregnant women or mothers based on the inclusion and exclusion criteria after receiving written informed consent from the participants. Patients not having any symptoms of cold, cough, and fever and HCWs working for more than 3 months and did not have any symptoms of cold, cough, and fever were included in the study, whereas patients and HCWs not willing to participate and were below 18 years of age were excluded from the study. Samples were collected in sterile saline tubes and then inoculated on mannitol salt agar, MacConkey agar, and blood agar in the microbiology lab. After 24 h, gram stain using Hucker’s technique and biochemical reactions as per isolated organism was performed.

Results

Overall 160 hand and nasal swabs were collected and processed for isolation and identification of bacteria. Hand swabs collected from 40 patients demonstrated that growth was seen in only seven swabs (17.5%). Among 40 doctors, growth was seen in five swabs (12.5%), and among 40 housekeeping staff and 40 nurses, growth was seen in 21 swabs (52.5%) and 10 swabs (25%), respectively. Table 1 demonstrates the analysis of hand swabs of healthcare workers and patients.

Organisms isolated from hand swabs of healthcare workers and patients are described in Table 2.

Nasal swabs collected from 40 patients demonstrated that growth was seen in only three swabs (7.5%). Among 40 doctors, growth

was seen in two swabs (5%), and among 40 housekeeping staff and 40 nurses, growth was seen in 13 swabs (32.5%) and five swabs (12.5%), respectively. Table 3 demonstrates the analysis of nasal swabs of healthcare workers and patients.

Organisms isolated from nasal swabs of healthcare workers and patients are demonstrated in Table 4.

Discussion

The results of the study demonstrated that patients involving pregnant women or mothers from the community area showed

Table 1: Hands swabs of healthcare workers and patients

Participants	Total	No growth	Growth
Mothers	40	33	7
Doctors	40	35	5
Housekeeping staff	40	19	21
Nurses	40	30	10

Table 2: Organisms isolated from hand swabs of healthcare workers and patients

Microorganisms	Mothers	Doctors	Housekeeping staff	Nurses
<i>Escherichia coli</i>	2	2	4	3
<i>Citrobacter freundii</i>	1	0	0	0
<i>Pseudomonas aeruginosa</i>	2	0	2	2
<i>Enterobacter</i>	2	0	0	0
<i>Staphylococcus aureus</i>	0	2	8	3
CONS	0	0	3	0
<i>Acinetobacter</i>	0	1	1	2
<i>Klebsiella pneumoniae</i>	0	0	2	0
MRSA	0	0	1	0

CONS=Coagulase-negative *Staphylococci*, MRSA=Methicillin-resistant *S. aureus*

Table 3: Nasal swabs of healthcare workers and patients

Participants	Total	No growth	Growth
Mothers	40	37	3
Doctors	40	38	2
Housekeeping staff	40	27	13
Nurses	40	35	5

Table 4: Organisms isolated from nasal swabs of healthcare workers and patients

Microorganisms	Mothers	Doctors	Housekeeping staffs	Nurses
<i>Proteus mirabilis</i>	1	0	0	0
<i>Streptococcus pneumoniae</i>	1	0	0	2
<i>Enterobacter</i>	1	0	0	0
CONS	0	2	1	3
<i>Escherichia coli</i>	0	0	3	0
<i>Proteus vulgaris</i>	0	0	2	0
<i>Staphylococcus aureus</i>	0	0	3	0
MRSA	0	0	1	0
<i>Pseudomonas aeruginosa</i>	0	0	3	0

CONS=Coagulase-negative *Staphylococci*, MRSA=Methicillin-resistant *Staphylococcus aureus*

the presence of diverse bacteria on their hands and nose, which is related to their daily work schedule, where they come in contact with many different items at home, the workplace, or the market. Generally, they wash their hands with soap and water, but still, some bacteria are left behind on their hands. The presence of bacteria in the nose is due to the inhalation of atmospheric air. Doctors frequently use hand sanitizer and wear masks and gloves most of the time that is why the organisms isolated were very low. Housekeeping staff touches many infected items and changes bedsheets and clothes; they are also responsible for the cleanliness and discarding of contaminated or infected materials, so their chances of getting infected and spreading infection are much more. Therefore, the most common organism MRSA has been detected in this group. As nurses interact with patients more than doctors and also come in contact with infected clothes, syringes, catheters, stool, and urine, therefore, the bacterial carriage is more than doctors, but unlike housekeeping staff, nurses take proper precautions, therefore, the bacterial carriage is less than that of housekeeping staffs. Steps of handwashing would minimize the risk of transmission of infection.

According to surveillance of Duerink *et al.* regarding HAIs and their exposure to risk factors, it was found that 2.8% of all patients had phlebitis, 0.9 and 1.7% had urinary tract and surgical site infections (UTI) and (SSI), respectively, and 0.8% had septicemia in one hospital; whereas, in another hospital 1.8% had SSI, 3.8% had phlebitis, 0.8% had septicemia, and 1.1% had UTI. Similarly in a previous research, the prevalence was 2.6% phlebitis, 1.8% SSI, and 0.9% UTI as reported by the first team, and 2.6% SSI, 2.2% phlebitis, 0.9% septicemia, and 3.5% UTI as reported by the second team. A significant difference in prevalence rates was found in the above-mentioned results indicating insufficiency of the surveillance reliability. The surveillance strategy enables hospitals in nations with limited healthcare resources to assess their level of HAI and enhance their infection control. The current study presented the percentage of organisms and not the infection, but if the percentage of infection is estimated, it would be quite similar with that percentage.^[10]

A prospective HAI surveillance of neonates in Brazil reported that 22% of the 4,878 neonates were found to have at least one HAI involving all neonates that were monitored till discharge. The overall incidence was 24.9 per 1,000 patient days, while maternally acquired *Enterobacter* species, Coagulase-negative staphylococci, *Klebsiella pneumoniae*, and *S. aureus* accounted for 28.1% of all HAIs. HAI is related to 40% of all the fatalities. In the present study, the mothers were considered as patients, and the percentage of infections was found to be lower in comparison to neonates as neonates do not have a healthy immune system. Hence, HAI can be potentially fatal.^[11]

To identify the presence of antibiotic-resistant gram-negative bacteria among healthcare professionals working in a Vietnamese intensive care unit, Duong *et al.* conducted a survey in which rectal swabs were required of every HCW on a weekly basis. Out of 40 participants, 26 (65%) had extended

spectrum β -lactamases (ESBL)/AmpC β -lactamase-producing *Escherichia coli*. ESBL/AmpC β -lactamase-producing *K. pneumoniae* colonized two HCWs. Ten out of 40 HCWs were found to be persistent and frequent carriers, and one HCW had *Acinetobacter baumannii* colonization. To lessen the transmission of antibiotic-resistant gram-negative bacteria in the hospital, it is necessary to screen HCWs for antibiotic-resistant gram-negative bacteria and to increase HCW compliance with hand cleanliness. Because the rectal area has more pathogens than the hands and nose, in comparison to the current study, so there may be a lower percentage of gram-negative organisms.^[12]

The introduction of alcohol-based hand rubs and ongoing educational programs are important in overcoming infrastructure barriers and constructing adequate knowledge improvement, according to Allegranzi *et al.*,^[13] who promoted the importance of hand hygiene and its role in healthcare workers. For projects involving hand hygiene, support from healthcare administrators and commitment from the local and national governments is essential. In the present study, it is therefore advised that education regarding proper hand washing techniques and their importance to patients and HCWs is therefore recommended.

Kim *et al.* also conducted a study on prevalence and surveillance and found that *S. aureus* was identified at a rate of 18.2%, with MRSA accounting for 0.7% of the total. Antimicrobial resistance tests found that MRSA was completely resistant to penicillin and cefoxitin. Furthermore, resistance to tetracycline (62.1%), erythromycin (55.2%), and clindamycin (55.2%) were rather high, and 27 of the 29 MRSA isolates showed multidrug resistance. In conclusion, this study demonstrated a higher incidence of MRSA as compared to the present study.^[14]

As this study is surveillance-based, it has certain limitations, which involve a lack of awareness of the responsibility to report or which disease must be reported. Sometimes reporting takes time as it is a lengthy and confusing form or procedure with the absence of feedback. The uncooperative nature, which involves not following the procedure properly, may lead to variation in results, which can also occur due to a small sample size making it a challenge to evaluate if a specific outcome is a true finding as, in some cases, a type II error may occur, that is the null hypothesis is not correctly considered, and no difference is reported between the study groups. Additionally, as this study involves a small sample size due to less prevalence so it might be possible that if the sample size is increased percentage might have increased, just like the above studies. There should be routine training to practice good hygiene conditions, aseptic techniques, and how to use personal protective equipment. Additionally, preventive measures and awareness about the spread of airborne, droplets, and nosocomial infections should be considered.

Conclusion

The highest prevalence of bacterial carriage was found in housekeeping staff followed by nurses, patients (pregnant

women/mothers), and doctors. In housekeeping staff, the bacterial carriage is 52.5% on the hands and 32.5% in the nose, in nurses 25% on the hands and 12.5% in the nose, in mothers 17.5% on the hands and 7.5% in the nose, and in doctors 12.5% on the hands and 5% in the nose. In hand swabs, the total bacterial carriage was 26.87%, and maximum individual organisms carriage was seen in *E. coli* (28.8%), followed by *S. aureus* (28.88%), *Pseudomonas aeruginosa* (13.33%), *Acinetobacter* (8.88%), *CONS* 6.66%, *Klebsiella pneumoniae* 4.44%, *Enterobacter* 4.44%, *Citrobacter freundii* 2.22%, and *MRSA* 2.22%. The total bacterial carriage in the nasal swabs was 14.37%, and maximum individual organism carriage was seen in *CONS* 26.08%, *S. aureus* 13.04%, *E. coli* 13.04%, *S. pneumoniae* 13.04%, *P. aeruginosa* 13.04%, *Proteus vulgaris* 8.69%, *Proteus mirabilis* 4.34%, *MRSA* 4.34%, and *Enterobacter* 4.34%. As a result, due to the small sample size, the study demonstrated less prevalence; hence, an increase in sample size can be considered for the future scope of the study.

MRSA was found only in housekeeping staff, and they were advised to use topical 2% mupirocin and chlorohexidine body bath, and others were advised to follow steps of hand rubbing and hand washing as per hospital and universal guidelines. Hence, to prevent nosocomial infections, the hospital staff should take proper measures to prevent the spread of infections and their drug-resistant strains.

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Conflicts of interest

There are no conflicts of interest.

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