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Antibiogram of Methicillin Resistance Coagulase Negative Staphylococci from Nasal Carriage of Healthcare Workers in a Tertiary Care Hospital

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Abbreviations: CoNS: Coagulase Negative Staphylococci; HCWs: Health Care Workers; CLSI: Clinical and Laboratory Standard; ASM: American Society for Microbiology; MHA: Muller Hinton Agar; OD: Optical Density

ABSTRACT

Introduction: The commensal microflora like coagulase negative staphylococci (CoNS) is recently considered as emerging pathogen which are crucial for causing nosocomial, so studies on the distribution and pattern of antibiotic resistance along with its virulence properties for health care workers (HCWs) are important as they can be responsible for transmission of multi drug resistant bacteria to community .The aim of our study was to determine the rate of nasal carriage of methicillin resistance coagulase negative Staphylococci (MRCoNS) among HCWs in Manmohan Memorial Teaching Hospital, Kathmandu, Nepal.

Methods: A laboratory-based cross sectional study was conducted over a period of six months (March 2019-August 2019). One hundred seventy-two nasal swabs were collected from HCWs and bacterial isolates were identified using the standard microbiological methods. Coagulase negative Staphylococci (CoNS) isolates were tested for methicillin resistance using the cefoxitin disk test and the resistance to other drugs was determined by Kirby-Bauer disk diffusion method according to clinical and laboratory standard (CLSI) guidelines. Biofilm formations by CoNS by tissue culture plate method were determined to assess their virulence.

Results: Among 172 nasal samples, 114 CoNS were isolated and among which 79 (45.9%) were MRCoNS.The overall rate of nasal carriage of MRCoNS among HCWs was 45.9%. Colonization of MRCoNS was higher among female than male. Laboratory personnel showed the highest colonization which was 52.9 %. Intensive care unit (ICU) ward was found to be the highest colonization with MRCoNS. Among the 114 isolates of CoNS, 37.8% were biofilm producers. All MRCoNS were sensitive to Linezolid and Vancomycin.

Conclusion: Rate of nasal carriage MRCoNS is high among HCWs and hence needs special attention to prevent HCWs associated infections. The high rate of nasal carriage of MRCoNS found in the study indicates for a need for standard infection control precautions to be applied in professional practice to decrease the rate of carriage and so on the rate of transmission. Nasal colonization by biofilm forming CoNS is at an alarming rate which may add more burden in the control of medical device associated infections.

Keywords: Nasal Carriage; CoNS; MRCoNS; HCWs; Nosocomial Infections

Introduction

Staphylococci are a genus of gram-positive bacteria which are arranged in grape-like clusters, non- motile, non-sporing, occasionally capsulated, facultative anaerobes and which are classified into S.aureus and Coagulase negative Staphylococci [1]. CoNS species such as Staphylococcus epidermidis and Staphylococcus haemolyticus which may colonize permanently or temporary at the anterior nares, skin, mucosa membrane which may later cause bacteremia or other infections [2]. Staphylococcus Cassette chromosome mec (SCC mec) is wide spread in CoNS has low affinity for most synthetic penicillin and for beta lactam antibiotics. Methicillin resistant Coagulase Negative Staphylococcus (MRCONS) and Methicillin- sensitive Staphylococcus aureus (MSSA) share the same ecological niche in humans, so transfer of SCC mec can occur from MRCONS to MSSA [3]. The most frequent carriage site of Staphylococcus species is the anterior nares and human skin and healthcare workers play an important role in the spreading of the resistant strains [4]. Healthcare workers carry pathogenic and opportunistic bacteria in the nasal cavity and transmit the organism to other healthcare workers and to patients [5]. Due to the presence of multidrug resistant and methicillin resistant strain, it creates a challenge if they are found in health care workers as because they may serve as reservoirs, vectors or victims of drug resistant bacteria. CoNS show widespread macrolide resistance due to efflux encoded by msrA than in S. aureus. Expression of MLSB resistance in staphylococci may be constitutive (MLSBc) or inducible (MLSBi) [6,7].

If expression is constitutive, the strain showed resistant to all MLSB antibiotics and if expression is inducible, the strains are in vitro resistance to 14- and 15-membered macrolides (e.g., erythromycin) while appearing susceptible to 16-member macrolides, lincosamides, and type B streptogramins [8]. As the virulence factor like biofilm and beta-lactamase seems to be present in the normal flora of an individual, it is necessary to screen the normal flora of the healthcare workers who are posted to high risk units where implantation and catheterization are carried out [9]. Currently, Staphylococcus epidermidis is a major cause of nosocomial sepsis and are the most leading organisms being responsible for causing infections related to implanted medical devices [10]. The identification of the antimicrobial properties of CoNS and biofilm production among healthcare workers is important for diagnosis and to prevent the rate of transmission to patients. Various studies have reported MRCONS nasal carriage rates from 3-60% among HCW'S [11]. In the study by Baragundi Mahesh et al., 59.10% were coagulase negative staphylococci and 32.97% were MRCoNS [12]. Kalsoon F et al. in 2008 have reported 46% and 12.98% of CoNS and MRCoNS respectively in HCWs [13]. From the above mentioned information, it is clear that the prevalence of nasal carriage MRCoNS is matter of concern worldwide as healthcare workers (HCWs) who are in continuous contact with patient are at risk to colonization and working in hospital may become reservoir or victim of drug resistant and may spread pathogens to community leads to terrible condition. In this perspective, we aimed to perform surveillance in this subject to know the status of nasal carriage of health workers by CoNS and MRCoNS along with their antimicrobial profile, which has become important to select proper treatment options for these carriers.

Materials and Methods

A laboratory-based descriptive cross-sectional study was conducted over a period of six months (March 2019-August 2019) among the healthcare workers of Manmohan Memorial Teaching Hospital, Kathmandu, Nepal. The nasal swabs of healthcare workers were collected that met the criteria recommended by the American Society for Microbiology (ASM) were selected for further processing and analysis, otherwise excluded.

Sample Collection

Nasal swabs were collected using a sterile cotton swab which was moistened in normal saline. The swab was introduced 1-2 cm in the nasal cavity and rotated 3 times both clockwise and anticlockwise. For a single specimen, the sample was collected from both nostrils using the same swab [14].

Isolation and Identification of CoNS

Nasal swabs were inoculated onto blood agar and Mannitol salt agar. Coagulase Negative Staphylococci were identified after 24 hours of incubation at 370 C by examining colony morphology, gram staining, oxidase test, catalase test, slide coagulase test and tube coagulase test.

Antibiotic Susceptibility Testing

The antibiotic sensitivity testing of CoNS isolated from a nasal swabs was performed by a modified Kirby disk diffusion method on Mueller Hinton Agar using standard methods recommended by CLSI guidelines. The predetermined antimicrobial disk was placed on the surface of the prior inoculated agar plate such that there will be a distance between the disc and 15 mm distance from the disc to edge. The antibiotics tested were Amoxicillin (10µg), Cefepime (30µg), Cefoxitin (30µg), Ciprofloxacin (5µg), Clindamycin (2µg), Doxycycline (30µg), Azithromycin (15µg), Cotrimoxazole (25µg), Erythromycin (15µg), Gentamycin (10µg), Linezolid (30µg), Levofloxacin (5µg), Tetracycline (30µg), Vancomycin (30µg). Then the plate was incubated aerobically at 37ºC overnight. After overnight incubation, the diameter of the zone of inhibition of each disc was measured (including the diameter of the disc) and recorded in millimeters. The result was interpreted as per the guideline of

CLSI zone size interpretative chart in terms of "sensitive', "resistant" and "intermediate sensitive [15].

Detection of MRCoNS

All isolated CoNS were tested with 30µg Cefoxitin on Muller Hinton Agar for MRCoNS screening. For each strain, a bacterial suspension adjusted to 0.5 MC Farland was used. The zone of inhibition was determined after 24hr incubation at 35ºC. Zone size was interpreted according to CLSI guidelines [16].

Detection of iMLSB

CoNS isolates were selected based on Erythromycin (E)-resistance and Clindamycin (CD)-sensitivity following CLSI guidelines. These isolates were tested for inducible resistance using D-test. 0.5 McFarland equivalent suspension of organisms was inoculated into Muller Hinton Agar (MHA) plate as described in CLSI recommendations. CD (2µg) and E (15µg) disc were place 15mm apart from the center of MHA. Plates were analyzed 18 hours of incubation at 35ºC.Interpretations of the diameters of the zone of inhibition were performed as recommended by CLSI i.e. E-sensitive ≥ 23 mm, E-intermediate resistance 14-22 mm, E-resistance ≤ 13 mm; CD-sensitive ≥ 21 mm, CD intermediate resistance 15-20 mm and CD –resistance ≤ 14 mm. If the E zone was ≤ 13 mm and the CD zone was ≥ 21 mm and both having a circular shape, the organism was considered negative for inducible resistance (D-test negative). If the E-zone was ≤ 13 mm and the CD zone was ≥ 21 mm with a D-shaped zone around the CD, the organism was considered positive for inducible resistance (D-test positive) [17].

Evaluation of Biofilm Production by Tissue Culture Method or Microtiter Plate Method

Quantitative microtiter plate method was used for the detection of biofilm. Organisms which were isolated from fresh agar plating were inoculated in 2 ml of Luria Brutani broth with 2% glucose and incubate at 37ºC for 24 hours. The cultures were then dilute at a ratio of 1:100 with fresh medium. Sterile polystyrene tissue culture plate wells were inoculated with 200 µl of the diluted culture of different strains isolated from nasal swabs and incubated at 37º C for 24 hours. After incubation, the remaining contents from each well were removed by gentle tapping and washed with 0.2 ml phosphate buffer saline (pH 7.2) three times, so free-floating bacteria are removed. Biofilms formed by bacteria adherent to the wells were fixed by keeping at 60º C for 1 hour and were stained by crystal violet (2%). Excess stain was removed by using deionized water by rinsing three times and subsequently decolorized with 30% acetic acid. Optical density (OD) of stained adherent biofilm was obtained by using micro ELISA auto-reader at wavelength 570 nm. Uninoculated wells containing broth were considered as negative control. The interpretation of biofilm production was done according to criteria of Stepanovic et al. Optical density cut-off value (ODC) was defined as three standard deviations (SDs) above the mean OD of negative control [18,19].

Ethical Consideration

Ethical approval was taken from Institutional Review Committee (Registration No. 395/2076) of Manmohan Memorial Institute of Health Sciences (MMIHS), Kathmandu. Informed written consent was taken from every participant after explaining the objective of the study.

Data Analysis

Each sample was encoded with an identification number. Similarly, the findings was recorded manually and entered into database. Analysis was one by SPSS version 20 and interpreted according to frequency distribution percentage and chi-square test.

Results

Distribution of MRCoNS Bacterial Isolates

Total 172 healthcare workers enrolled in the study were 39 (22.7%) males and 133 (77.3%) females. Among them, 114 (66.2%) healthcare workers were found to be carriers of Coagulase Negative Staphylococci. Overall distribution of MRCoNS was found to be 45.9% (79/172) among HCWs. Age wise spreading of methicillin sensitive CoNS (MSCoNS) was the uppermost (22.9%) in 21-30 years group whereas MRCoNS (83.3%) was in age group of 41-50 years. A higher number of MRCoNS (47.4%) found in females (47.4%) than in males (23.1%).The greatest percentage of MSCoNS and MRCoNS was obtained among the HCWs from the Laundary (33.3%) and ICU (100%), respectively. Likewise, the most dissemination of MSCoNS and MRCoNS was attained in the profession of receptionist (100%) and laboratory (52.9%), respectively (Table 1).

Table 1: Distribution of MRCoNS bacterial isolates.

Organism distribution	MRCoNS, n (%)	MSCoNS, n (%)	Not isolated, n (%)
Age (year)			
21-30 (n=109)	48 (44.4)	25 (22.9)	36 (33.0)
31-40(n=57)	26 (45.6)	10 (17.5)	21 (36.8)
41-50(n=6)	5 (83.3)	0 (0)	1 (16.7)
Sex			
Male (n= 39)	16 (41.0)	9 (23.1)	14 (35.9)
Female (n= 133)	63 (47.4)	26 (19.5)	44 (33.1)
Hospital Wards			
Lab (n=43)	23 (53.5)	6 (14.0)	14 (32.6)
Medical (n=27)	9 (33.3)	4 (14.8)	14 (51.9)

Gynecology (n=14)	9 (64.3)	3 (21.4)	2 (14.3)
ICU (n=2)	2 (100)	0 (0)	0 (0)
Surgical (n=11)	6 (54.4)	1 (9.1)	4 (36.4)
OPD (n=52)	26 (50.0)	14 (26.9)	12 (23.1)
Laundary (n=3)	0 (0)	1 (33.3)	2 (66.7)
Emergency (n=20)	4 (20.0)	6 (30.0)	10 (50.0)
Profession			
Doctor (n=13)	5 (38.5)	4 (30.8)	4 (30.8)
Nurse (n=43)	18 (41.9)	6 (14.0)	19 (44.2)
Lab staff (n=34)	18 (52.9)	3 (8.8)	13 (38.2)
Cleaner (n=44)	21 (47.7)	14 (31.8)	9 (20.5)
Attender (n=13)	6 (46.2)	1 (7.7)	4 (46.2)
Receptionist n= (2)	0 (0)	2 (100)	0 (0)
Administrative n= (13)	6 (46.2)	2 (15.4)	5 (38.5)
Pharmacist n= (10)	5 (50)	3 (30)	2 (20)
Total n= (172)	79 (45.9)	35 (20.3)	58 (33.7)

Antibiogram pattern of MRCONS

Out of 14 different antibiotics used for susceptibility test of MRCONS, the most effective were Vancomycin and Linezolid (100%) followed by doxycycline (82.3%) and ciprofloxacin (78.5%). The highest resistant was found to be amoxicillin, cefoxitin, ceftriaxone and cefepime and followed by Erythromycin (96.2%) and clindamycin (92.4%) (Table 2).

Table 2: Antibiogram pattern of MRCONS.

Antibiotics	CoNS		MRCoNS	
	Sensitive	Resistance	Sensitive	Resistance
Cefoxitin	0 (0 %)	79 (100%)	0(%)	79 (100%)
Amoxicillin	34 (97.1%)	79 (100%)	0(%)	79 (100%)
Ceftriaxone	0 (0%)	79 (100%)	0(%)	79 (100%)
Cefepime	0 (0%)	79 (100%)	0(%)	79 (100%)
Erythromycin	34 (97.1%)	76 (96.2%)	3 (3.8%)	76 (96.2%)
Clindamycin	15 (42.9%)	73 (92.4%)	6 (7.6%)	73 (92.4%)
Azithromycin	30 (85.7%)	63 (79.7%)	16 (20.3%)	63 (79.7%)
Cotrimoxazole	10 (28.6%)	41 (51.9%)	38 (48.1%)	41 (51.9%)
Levofloxacin	2 (5.7%)	19 (24.1%)	60 (75.9%)	19 (24.1%)
Tetracycline	4 (11.4%)	18 (22.8%)	61 (77.2%)	18 (22.8%)
Ciprofloxacin	3 (8.6%)	17 (21.5%)	62 (78.5%)	17 (21.5%)
Doxycycline	3 (8.6%)	14 (17.7%)	65 (82.3%)	14 (17.7%)
Vancomycin	0 (0%)	0 (0%)	79 (100%)	0 (0%)
Linezolid	0 (0%)	0 (0%)	79 (100%)	0 (0%)

Erythromycin and Clindamycin susceptibility pattern of MRCONS

Erythromycin and Clindamycin resistance was found to be higher in MRCoNS strain (88.6%) in comparison to MSCoNS strains (42.87%). Similarly, iMLSB was found to be higher in MSCoNS strain 14 (40%) (Table 3).

Table 3: Erythromycin and Clindamycin susceptibility pattern of MRCONS.

Resistance pattern	CoNS	MRCoNS	MSCoNS
E-S, CD-S	1 (0.87%)	0 (0%)	1 (2.8%)
E-R, CD-R	85 (74.56%)	70 (88.6%)	15 (42.87%)
E-R, CD-S(D+)	17 (14.93%)	3 (3.8%)	14 (40%)
E-R, CD-S(D-)	8 (7.01%)	3 (3.8%)	5 (14.28%)
E-S, CD-R	3 (2.63%)	3 (3.8%)	0 (0%)
Total	114 (100%)	79 (100%)	35 (100%)

Biofilm forming pattern of MRCONS

Out of 79 MRCoNS isolated, 51 (64.6%) producers .Among 35 MSCoNS, 20 (57.1%) (Table 4).

Table 4: Biofilm forming pattern of MRCONS.

Biofilm CoNS	MRCoNS	MSCoNS
Strong 2 (1.8%)	1 (1.3%)	1 (2.9%)
Moderate 2 (1.8%)	2 (2.5%)	0 (0%)
Weak 39 (34.20%)	25 (31.6%)	14 (40%)
Negative 71 (62.30%)	51 (64.6%)	20 (57.1%)
Total 114 (100%)	79 (100%)	35 (100%)

Antibiotic Resistant Patterns Among Biofilm Producers and Nonproducers

High degree of antimicrobial resistance was exhibited by erythromycin (95.3%) followed by Amoxicillin (76.7%), Azithromycin (76.7%) and Clindamycin (74.45) in biofilm producers. Vancomycin and Linezolid did not show any resistance in biofilm producers. In non-biofilm producers, Erythromycin (97.2%), Amoxicillin (84.5%) and Azithromycin (84.5%) exhibited high drug resistance. Similarly, Vancomycin and linezolid did not show any resistance in non-biofilm producers (Table 5).

Table 5: Biofilm forming pattern of MRCONS.

Antibiotic producer	biofilm	non biofilm producer
Cefoxitin	28(65.1%)	51(71.8%)
Amoxicillin	33(76.7%)	60(84.5%)
Cefepime	28(65.1%)	51(71.8%)

Gentamycin	6(14%0	8(11.3%)
Erythromycin	41(95.3%)	69(97.2%)
Clindamycin	32(74.4%)	56(78.9%)
Ciprofloxacin	5(11.6%)	15(21.1%)
Levofloxacin	6(14.0%)	15(21.1%)
Azithromycin	33(76.7%)	60(84.5%)
Cotrimoxazole	16(37.2%)	35(49.3%)
Ceftriaxone	28(65.1%)	51(71.8%)
Doxycycline	4(9.3%)	13(18.3%)
Tetracycline	8(18.6%)	14(19.7%)
Vancomycin	0(0%)	0(0%)
Linezolid	0(0%)	0(0%)

Discussion

Coagulase negative staphylococci (CoNS) are frequently present on human skin which were considered nonpathogenic organisms and were recognized as contaminants [20]. Since the last few years, various studies have shown that CoNS are an emerging group of pathogens [21]. Many studies have been done on nasal carriage of S. aureus and MRSA among HCWs but studies on nasal carriage of CoNS in HCWs are few. Thus, it is necessary to determine the nasal carriage of methicillin resistant CoNS among HCWs, along with its antimicrobial susceptibility pattern. Out of 172 healthcare workers participated in study, 39 were male and 133 were female. We included doctors, nurses, lab staffs, cleaners, attenders, administrative, and pharmacists. The age of HCWs involved in our study ranged from 21-50 years. In our study, the rate of nasal carriage CoNS was found to be 66.2% (114/172). In the study performed in 2014 by Kaur and Narayan, et al. in India, was found to be 52.14% [22]. In contrast, our study showed low prevalence of nasal carriage of CoNS in comparison with the study performed by Akhtar N in Pakistan which was found to be 73.3% [15]. Likewise, in the study by Qiao Fu, et al. [23] in China showed 60.2%, which was nearly similar to our study [23]. In our study, the overall rate of nasal carriage of MRCoNS was found to be 45.5%. In a study by Baragundi Mahesh C, et al. [12], nasal colonization of MRCoNS among HCWs was found to be 32.97% which was nearly similar to our study [12]. Whereas the study performed by Kaur DC, et al. [22] and the study by Agarawal L et al.in India showed lower rate of MRCoNS which was 24.29% and 7.6% respectively [22,24].

Similarly, the study conducted in Pakistan by Akhtar N showed 2.1 % nasal colonization by MRCoNS which was very low [15]. In contrast to other studies including community skilled nursing facility nursing personnel, 60% were colonized by MRCoNS, which was comparatively higher than our study [25]. Such a difference in the rate of nasal colonization by CoNS and MRCoNS among HCWs may be attributed to different factors such as sampling techniques, culture methods, identification of MRCoNS basis, study population, study criteria, hospital environment, etc. Antimicrobial resistance has emerged as one of the vital microbial threats of twenty-first century. The factors which are responsible for causing the resistant forms of staphylococci are extensive use of antibiotics, extended hospital stay, lack of awareness, and taking antibiotics before visiting the hospital [26]. All isolate CoNS (both MRCoNS and MSCoNS) were sensitive (100%) to Vancomycin and Linezolid. MRCoNS show less resistance to doxycycline (17.7%), Ciprofloxacin (21.5%), and Tetracycline (22.8%). Low resistance of those antibiotics towards MRCoNS indicates that these antibiotics might be an option for empirical therapy of MRCoNS infection in our hospital. Similarly, all isolated MSCoNS were sensitive to Cefoxitin, Ceftriaxone Cefepime. Less resistances were shown by levofloxacin (5.7%), followed by ciprofloxacin (8.6%), doxycycline (8.6%) and tetracycline (11.4%). Similarly, above-mentioned antibiotics might be implicated for empirical therapy for MSCoNS infection in our hospital. Similarly, all isolates were sensitive to vancomycin and linezolid in a study performed by Akhtar N and a study performed by Agarwal L et al. respectively [15,24].

Antibiotic susceptibility patterns might be similar due to similar environment settings and commonly used antibiotics patterns. Among 114 isolates, 1 (0.87%) was sensitive to both erythromycin and clindamycin and 85 (74.56%) were resistant to Erythromycin and Clindamycin. Similarly, 17 (14.93%) were resistant to erythromycin and sensitive to Clindamycin with D-test being positive (inducible Macrolide, Lincosamide, Streptogramin B resistance). D-test positive was higher in MSCoNS, i.e., 40 % in comparison to MRCoNS which was 3.8 %. Whereas iMLSB resistance among MRCoNS strains was higher in the study performed by Baragundi M et al. [12] which was shown to be 16.39% [12]. The difference in findings may be due to different factors such as study population, setting and microbiological techniques, etc. The double-disc diffusion test is necessary to correctly discriminate between inducible CL-R and susceptibility to CL [27]. Among 114 isolated CoNS, 71 (62.30%) were biofilm non-producers, and 43 (37.8%) were biofilm producers. Biofilm was higher among MSCoNS i.e.42.9% than in MRCoNS i.e. 35.4%. In the study by Shrestha LB, et al. [19] biofilm formation was observed in 65.38% of the isolates from various clinical samples and in the study by Devapriya F, et al. [9] from throat and nasal mucosa of healthy volunteers 64.4% were biofilm producers [9,19]. Both studies showed biofilm formation was higher than ours. High rates of biofilm forming nasal carriage CoNS among HCWs increase the risk of medical device associated staphylococci infection in patients.

Hence, regular screening of nasal carriage biofilm forming CoNS among HCWs along with methicillin resistance is essential. High

degree of antimicrobial resistance was exhibited by Erythromycin (95.3%) followed by Amoxicillin (76.7%), Azithromycin (76.7%) and Clindamycin (74.4%) in biofilm producers. In non- biofilm producers, Erythromycin (97.2%), and Amoxicillin (84.5%) exhibited high degree of resistance. Vancomycin and linezolid did not show any resistance in biofilm as well as in non-biofilm producers. Similarly, in the study by Mishra Sk, et al. [18] showed the most effective antibiotics for biofilm producing Gram positive isolates were vancomycin which was also similar to our study [18]. Profession wise, our study showed the highest MRCoNS colonization among lab personnel (52.9%). Lab personnel are at risk as they become infected with bacteria through uncertain exposure in laboratories. The healthcare workers may be asymptomatic carriage which causes transmission of multidrug resistant bacteria to the community [28]. In the study by Agarwal L et al. shows, a higher carrier rate of CoNS was found among nursing students was 53% [24]. While Kulshrestha N, et al. [29] and Kashid RA, et al. [21] in India reported MRCoNS were highest among anterior nares of doctors which was found to be 41.6% and 35.7% in anterior nares of doctors respectively [21,29]. Higher colonization of MRCoNS among doctors may be due to frequent patient contact. Ward wise, our study showed ICU was colonized highest 100% (2/2). Contamination of the environment of ICU plays a role in acquisition of nosocomial pathogens both by patients and healthcare workers.

However, in the study by Kulshrestha, N et al. [29] showed MRCoNS was 43% and 31% for anterior nares of doctors posted in ICU and OT, respectively [29]. Highest was among the doctors posted in ICU which showed similar results as our study where MRCoNS were highest in ICUs. The study by John Jr JF, et al. [30] showed nurses on the intensive care unit were colonized by MRCoNS higher, i.e., 73% than other wards [30]. Close contact of HCWs to admitted patients, had nasal and hand colonization of these multidrug resistant CONS, in the wards and ICUs can act as carriers. These carrier health workers are liable to transmit hospital acquired strains from one to another patients while treating and visiting them [11].

Conclusions and Recommendations

Our study showed the rate of nasal carriage of CoNS among healthcare workers to be 66.2%. Overall rate of nasal carriage of MRCoNS among health care workers was found to be 45.9%. Lab personnel were the major carriers of MRCoNS in comparison to other health personnel. Similarly, HCWs of ICU wards were the highest in MRCoNS colonization. Thus the high rate of nasal carriage of MRCoNS found in the study indicates for the need for standard infection control precautions to be employed in professional practice to minimize the rate of carriage or transmission rate. Methicillin resistance in CoNS may not only lead to treatment failure but also spread this resistance to Staphylococcus aureus which may pose a challenge to clinicians, so regular surveillance is required. Therefore, the ability of CoNS species to develop resistance to a broad spectrum of antibiotics needs consideration in the control and prevention of infections. In addition to antibiotic resistance, the virulence of CoNS is related to its capacity to produce biofilm, and such infection associated with biofilm is difficult to treat and have to be diagnosed earlier.

Limitations

The phenotypic methods for detection of resistance mechanisms like methicillin resistance in CoNS and iMLSB were performed and not confirmed via molecular methods. The study only tested the susceptibility patterns to commercially available concentrations of antibiotics. It does not provide information on the minimum inhibitory concentration of any particular antibiotics.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

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