Research Article

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MICROBIOLOGICAL PROFILE OF HIGH TOUCH AREAS OF CRITICAL AND NON-CRITICAL UNITS IN TEACHING HOSPITAL OF MADHYA PRADESH, INDIA

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ABSTRACT

In the current scenario, Nosocomial infections (NI) due to environmental contamination in shared settings of health care, are a serious public health issue affecting millions of people every year worldwide. Therefore, this study aims to create a microbiological profile of high touch areas of Critical and Non-Critical units in Teaching Hospital of Madhya Pradesh. This Cross-sectional Study deals with bacterial (aerobic and anaerobic) surveillance and its antimicrobial susceptibility testing which will aid in enlisting antimicrobial-resistant bacteria and guide us in the use of antimicrobials judiciously. A total of 128 samples were taken from Critical care units and non-Critical units from eight surface locations classified into categories of immediate patient environment and commonly used equipment. These samples were then processed for isolation and identification by standard methods. Out of 128 samples, 28 (21.8%) samples were culture positive for aerobic only and none for anaerobic bacteria. Among which more culture positive samples were isolated from non-Critical units 53.5%, topping the list of contamination were General Medicine ward and Gynecology ward (17.8 %). The majority of isolated microorganisms were *Staphylococcus aureus* of which 38.4% were MRSA. It showed maximum resistance for Ampicillin (AMP) and was most sensitive to Gentamicin (GEN). Present study highlights that control of *Staphylococcus aureus* infection (including MRSA) in hospitals is essential. It can be achieved by proper implementation of hospital infection control measures and regular surveillance activity.

Keywords: Nosocomial Infections, Methicillin Resistant *Staphylococcus aureus* (MRSA), High touch Areas, Critical units, Non-Critical Units

INTRODUCTION

Nosocomial infections (NI), also called “hospital-acquired or healthcare-associated infections” (HAIs) are a serious public health issue affecting hundreds of millions of people every year worldwide. The infection should not be present at the time of admission and the symptoms should appear at least after 48 hours of admission.[1]

The patient’s environment in the healthcare setting is largely responsible for the spread of infection from patient to patient and/or healthcare workers (HCWs) and are associated with increased mortality and morbidity.[2]

Environmental contamination is more prevalent when patients are managed in shared facilities (high-touch areas)[3]and current cleaning practices are inconsistent for mobile medical types of equipment with uncertainty between healthcare workers and environmental staff regarding cleaning roles, cleaning frequency, and cleaning methods.[4]

The commonly found HAIs include *Streptococcus* spp., *Acinetobacter* spp., *Enterococci, Pseudomonas aeruginosa (P. aeruginosa)*, Coagulase-negative *Staphylococci (CoNS), Staphylococcus aureus (S. aureus), Klebsiella pneumoniae (K. pneumoniae), Escherichia coli (E. coli)*.

Since bacteria plays a predominant role (approx. 90%) in causing HAIs,[5] this study majorly deals with bacterial surveillance and its antimicrobial susceptibility testing.

Extensive use of antimicrobials is the single most important factor for the bacteria to undergo mutation, which leads bacteria to become resistant and then these strains flourish exponentially.[6] Methicillin Resistant *Staphylococcus aureus* (MRSA) isolation rates from ICU and wards were higher than that seen among outpatients,[7] forming the basis of the present study set in the wards and ICUs. In the duration of 2015-2020, the pooled prevalence of MRSA zone-wise was found to be 36 % (95% CI: 25-47%) in the central zone.[8]

The analysis of this study will be helpful in understanding the causative bacteriological agents of nosocomial infections and will aid in enlisting antimicrobial-resistant bacteria and guide us in the use of antimicrobials judiciously.

MATERIALS AND METHODS

This Cross-sectional analytical study was conducted in the Department of Microbiology, in the Government Teaching hospital of Madhya Pradesh after obtaining ethical clearance from the Institutional Ethical Committee (IEC) (Ethical clearance number: A8/22/IEC /ABVGMC/ Vidisha/ 2022) over a time period of two months.

A total of 128 samples were taken from Critical care units in a teaching hospital.

Eight surface locations were chosen for testing, they were classified into two categories which are shown in Table 1.

The samples were collected using two sterile cotton swabs moistened with sterile saline. Swab was rotated and swabbed in a

standardized pattern within the defined area for each sampling point. One swab sample was then dipped in a sterile test tube with 1 ml of sterile peptone water, for detection of aerobic bacteria and other into a freshly prepared Robertson's cooked meat broth (RCMB) for detection of anaerobic bacteria which was then transported immediately to the microbiology laboratory for further processing as per standard guidelines described in Practical Microbiology of Mackie & MacCartney 14th volume[9] for former and Wadsworth anaerobic manual[10] for the latter.

Rationale: Controls used:
Control for Gram Negative organisms: *E.coli* ATCC -25922
Control for Gram positive organisms: *Staphylococcus aureus* ATCC - 25923

Table 1: Sample collected according to unit distribution from various surfaces in the Teaching hospital

Area of samples collected from critical units *(n=16)*	**Area of samples collected from non-critical units *(n=16)***
Area I: MICU	Orthopedics ward
Area II: : SICU	General Medicine ward
Area III: PICU	General Surgery ward
Area VI: NICU	Gynecology ward
Note: A total of 16 samples were collected from each unit, 8 for aerobic culture and 8 for anaerobic culture	
Eight surface locations	
A. Immediate patient environment 1. Crash cart 2. Bed side table 3. Patient Bed sheet 4. Bed frames	B. Commonly used equipment's 1. IV stands 2. BP apparatus 3. Stethoscopes 4. Glucometer
Note: Two samples were collected from each location, one for aerobic and one for anaerobic culture	

Table 2: Culture positivity amongst different units of various areas in the Teaching hospital

Critical units (aerobic + anaerobic n= 64 samples)		**Non-Critical units (aerobic + anaerobic n= 64 samples)**	
Area	**No. of positive culture (%) (n=28)**	**Area**	**No. of positive culture (%) (n=28)**
Area I: MICU	3 (10.7%)	Orthopedics ward	2 (7.1%)
Area II: SICU	4 (14.2%)	General Medicine ward	5 (17.8%)
Area III: PICU	3 (10.7%)	General Surgery ward	3 (10.7%)
Area VI NICU	3 (10.7%)	Gynecology ward	5 (17.8%)
Total	**13 (46.4%)**		**15 (53.5%)**

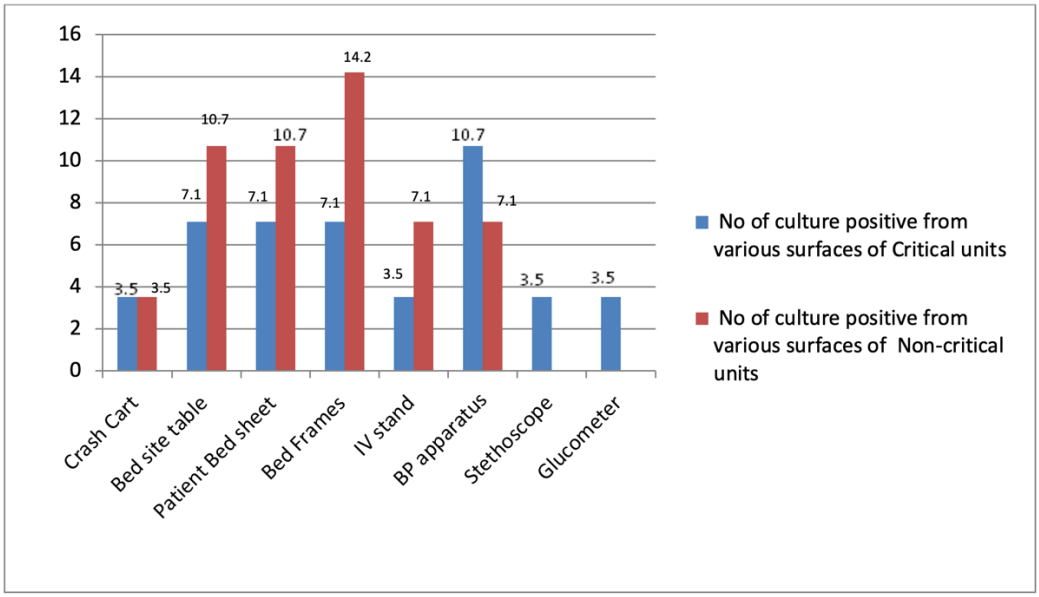

Figure 1: Culture positivity among different units of various surfaces in Teaching hospital

OBSERVATIONS AND RESULT

The distribution of culture-positive samples in different units of the various surfaces is shown in Table 2 and comparison between the culture positive samples of Critical and Non-Critical units is depicted in Figure 1.

In both Non-Critical Units and Critical Units, higher Infectivity was found in immediate patient environments 77% and 53.8% respectively compared to that of commonly used equipment 23% and 46.1% respectively.

Among the isolates from different areas and surfaces majority of microorganisms were *Staphylococcus aureus*26 (20.3%) followed by *Klebsiella pneumoniae* 2 (7.1 %).

The antibiotic susceptibility pattern showed that out of 26 *Staphylococcus aureus,* 10 (38.4%) were Methicillin resistant *Staphylococcus aureus* (MRSA). Among these 7 (26.9%) were from non-Critical units and 3 (11.5%) from Critical units. Methicillin sensitive *Staphylococcus aureus* (MSSA) was 16 (61.5%) of total *Staphylococcus aureus* isolates. *Staphylococcus aureus* showed maximum resistance to Ampicillin (AMP)

followed by Erythromycin (E), Clindamycin (CD). Most sensitive antibiotics to *Staphylococcus aureus* were found to be Gentamicin (GEN) followed by Ciprofloxacin (CIP) and Doxycycline (DOX).

Antimicrobial susceptibility pattern of *Klebsiella pneumoniae (n=2)* isolate was Norfloxacin -1 (50%); Ampicillin (AMP) - 2(100%); Ciprofloxacin (CIP)- 1(50%); Gentamicin (GEN)- 1(50%); Cefuroxime- 2(100%).

In total 75% of Beta Lactams included in our study were resistant to *Klebsiella pneumoniae*.

DISCUSSION

In the present study, less culture positives were from Critical units 13 (46.4%), among the 28 culture-positive samples which is in similarity with the study done by Jaiswal Archi *et al* [3.] These findings may correlate due to better sterilization and cleaning process carried out in Critical units, by implementation of strict guidelines.

In our study, the most contaminated areas were General Medicine and Gynecology ward -17.8%. In contrast, in a study done by Melkam Birru *et al* [11], the Surgical ward was the most contaminated area- 76.4%. This contrast may be due to differences in cleaning practices and patient load corresponding with manpower allocation in different areas.

In the present study, infectivity observed from the immediate patient environment was more compared to that of used equipment. A similar finding was seen in study done by Jaiswal Archi *et al*[4], stating the same, which may be attributed to lack of proper hand hygiene and disinfection practices in the immediate patient environment due to carelessness among the patient and attenders. It is comparatively less commonly used equipment, possibly due to its handling by healthcare workers who are comparatively more aware and attentive of nosocomial infections.

A similar study by Suhag N, Jain Arti, *et al* [12] and Teshale Worku *et al*[13], support our study as they also showed *Staphylococcus aureus* as the predominant organism isolated from inanimate objects in Critical and Non-Critical units.

A contrast study done by Laila Chaoui *et al*, [14] showed the predominance of Gram-negative bacteria (GNB). In our study Gram-negative bacteria, *Klebsiella pneumoniae,* was2 (7.1%) in number, which may be due to cross-transmission. Similar studies which showed a high percentage of *Klebsiella pneumoniae* isolates include study done by Melkam Birru *et al.*[11]

A lower percentage of Gram-negative isolates compared to the above-mentioned study may signify that methods of disinfection practiced in our hospital are successful against Gram-negative bacteria. Also, since the hospital setting of this study is a newer establishment, the chances of contamination may be less.

In the present study: 10 (38.4%) were MRSA and 16 (61.5%) were MSSA. A high incidence of MRSA strain was observed in a study done by Suhag N, *et al*[12] reporting 70% of MRSA. Whereas in the study done by Jaiswal Archi *et al*,[3] 5/31 (16.12%) of *Staphylococcus aureus* isolates were found to be MRSA strains.

These findings highlight the increasing incidence of MRSA strains from frequently touched areas of a hospital. These may be due to the non-judicious use of antibiotics which lead to mutant strains of *Staphylococcus aureus* and increase in their occurrence over the years.

In this study antimicrobial susceptibility pattern of *Klebsiella pneumoniae (n=2)* showed 100% resistance to Ampicillin (AMP); and 50% resistance towards Gentamicin (GEN). A similar study done by Teshale Worku *et al*[13] (2018), showed 38.4% of strains resistant to Ampicillin (AMP) and 23% of strains resistant to Gentamicin (GEN). This shows an increase in resistance of *Klebsiella pneumoniae* to Ampicillin and Gentamicin *i.e.,* Beta Lactams which may be due to increased use of these antimicrobials in our hospital and non-judicious prescription leading to mutant strains. In total 75% of Beta Lactams included in our study were resistant to *Klebsiella pneumonia.*

CONCLUSION

The present study highlights the fact that *Staphylococcus aureus* is the most common nosocomial infection-causing organism, and it needs to be checked by sensitization and training sessions regarding hand hygiene practices among healthcare workers and also patient attenders. For multi-drug resistant organisms like MRSA, regular cleaning of inanimate objects with suitable disinfectants as per hospital disinfection policy should be done to prevent hospital-associated infection to patients as well as HCW, as they can be a potential source of transmission of infection and prescription of susceptible antibiotics to prevent future antibiotic resistance should be done.

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