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RESEARCH ARTICLE

EPIDEMIOLOGY OF HOSPITAL ACQUIRED INFECTIONS AMONG PATIENTS ADMITTED IN THE INTENSIVE CARE UNIT IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Hospital - acquired infection (HAI) is a leading cause of morbidity and mortality among hospitalized patients that increases. More than 20% of all nosocomial infections are acquired in Intensive care unit (ICU). The risk of HAI in ICU is 5 to 10 times greater than those acquired in general medical and surgical wards. The emergence of resistance to antimicrobial agents has been increased in recent years. To ensure appropriate therapy current knowledge of the organisms causing HAIs and there susceptibility pattern is mandatory.

Aims and objectives: The purpose of this study is to evaluate the microbiological profile and the susceptibility pattern of the micro-organisms isolated from various samples of adult patients admitted in ICU and suspected of having hospital acquired infections after admission in a tertiary care hospital in Kolkata, West Bengal, India

Result: Total 120 samples from patients admitted in ICU were processed in the laboratory out of which, 70 (58.33%) showed culture to be positive and 50(41.67%) samples showed no growth of any organism. The rate of infection in ICU of our set-up was 56.25 %. Culture positivity was 71.92% among those having length of stay in ICU for >7 days. This association was statistically significant. 41.17% of blood samples, 88.23% of respiratory samples, 42.85% of urine samples and 100% of pus samples showed culture positivity. Culture positivity was associated with presence of in-situ devices and this association was found to be statistically significant. Pneumonia (43%) was found to be most common infections in the ICU of our set-up followed by blood stream infections (30%) and urinary tract infections (17%). Acinetobacter spp was found to be the most common agent causing bacteremia (42.85%) and pneumonia (40%) in our set-up. Most of the gram negative isolates specially Acinetobacter spp showed resistance to commonly prescribed antibiotics. Vancomycin and Linezolid resistance is also becoming common in the ICU setup along with prevalence of MRSA strains.

Conclusion: In ICU associated infections it is important to know the possible microorganisms and their sensitivity patterns for the success of the selection of the empiric antibiotic treatment. Regular surveillance of these infections to estimate the burden of infection is an essential step in the infection control and quality care assurance to patients.

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INTRODUCTION

HAI are infections acquired during hospital care which is not present or incubating at admission. Thus infections occurring more than 48 hours after admission are usually considered as HAI (Girard, 2002). Worldwide, HAI causes a significant burden both for the patient and for public health.

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At any time, over 1.4 million people worldwide suffer from infectious complications acquired in hospital (Gastmeier, 1998). Intensive care units (ICUs) account for fewer than 10% of total beds in most hospitals (Mayon-White, 1988) but more than 20% of all nosocomial infections are acquired in ICUs and it affects about 30% of patients in ICUs (Fridkin, 1997). The risk of HAI in ICU is 5 to 10 times greater than those acquired in general medical and surgical wards (Vincent, 2009). A likely explanation for this increased risk is that critically ill patients often require invasive medical devices such as urinary catheters, central venous and arterial catheters

and endotracheal tubes, that also for longer periods of time, thus compromising normal skin and mucosal barriers (Singh, 2013). The most frequent hospital acquired infections are urinary tract infections, lower respiratory tract infections, blood stream infections, and infections of surgical wounds (Rodjt, 2011 and Pollack, 2010). The infecting organisms may vary with different patient populations, health care settings and facilities. In recent years, infections caused by *Acinetobacter spp* has gradually increased, and the pathogen is more resistant and virulent and becoming serious nosocomial threat (Sunenshine, 2007). Generally it is considered that ICUs are epicenters of antibiotic resistance and main sources of outbreaks of multi-drug resistant bacteria. For HAIs important risk factors are over consumption of antibiotics exerting selective pressure on bacteria, frequent use of invasive devices and relative density of susceptible patients. Nowadays antibiotic resistance is a global problem and it is particularly pressing in developing countries including India. Antibiotic over use, misuse, and counterfeit antibiotic market combination and poor patient compliance, all contribute to wide spread drug resistance among hospital acquired infection. The pattern of organism causing infections and there susceptibility pattern vary widely from country to country, as well as hospital to hospital (Albrich, 1999). The emergence of resistance to antimicrobial agents has been increased in recent years. Not only bacteria but also fungi have a major impact on morbidity and health-care costs (Buke, 2009). To ensure appropriate therapy current knowledge of the organisms causing HAIs and there susceptibility pattern is mandatory. The purpose of this study is to evaluate the microbiological profile and the susceptibility pattern of the micro-organisms isolated from various samples of adult patients admitted in ICU and suspected of having hospital acquired infections after admission in a tertiary care hospital in Kolkata.

Aims and objectives

Our aim was to isolate and identify the different microorganism associated with hospital acquired infections in ICU and to determine their antimicrobial susceptibility pattern.

MATERIALS AND METHOD

The study was performed in a tertiary care hospital for a period of one year. Adult patients admitted in ICU who has developed new clinical signs and symptoms of infection after admission in hospital were included in the study. A case record form (pre-tested, semi-structured) with informed consent was used for data collection. Relevant history was taken and important clinical finding was noted. Sample was collected and processed following standard protocol.

RESULTS

Total 120 samples from patients admitted in ICU were processed in the laboratory, out of which 70 (58.33%) showed culture to be positive and 50(41.67%) samples showed no growth of any pathogen (Table 1). Study subjects were between 16 to 93 years of age. Age and gender of the study subjects were evaluated (Table 2) as a factor for association with infection but this association was not statistically significant. As showed in table 3, length of stay in ICU was considered a significant risk factor for infection and culture positivity was found to be 71.92% among those having length of stay in ICU for >7 days.

This association was statistically analyzed and it was statistically significant. Table 4 showed that culture positivity was associated with presence of in-situ devices. This association was found to be statistically significant. The most common nosocomial infection in our setup was pneumonia (43%) followed by bacteremia (30%), Urinary tract infections (17%) and wound infections (10%). Various aerobic bacteria causing different infections were identified in the present study. *Acinetobacter spp* (42.85%) was found to be the most common bacteria causing blood stream infections in our set-up followed by *Klebsiella spp* (19%), *Escherichia coli* (14.28%), *Staphylococcus aureus* (9.52%), Coagulase negative Staphylococcus (CoNS) (9.52%) *Enterococcus spp* (4.76%). *Acinetobacter spp*. (40%) was found to be the most common bacteria causing pneumonia in our ICU set-up.

Other important organisms causing pneumonia were *Pseudomonas spp* (20%), *Klebsiella* (23.33%), *Staphylococcu aureus* (3.33%), *E.coli* (6.66%) and *Candida spp* (6.66%). In the present study bacteria causing Urinary Tract Infection were predominantly *Escherichia coli* (33.34%), followed by *Klebsiella spp* (16.67%), *Pseudomonas* spp (8.33%), Proteus mirabilis (16.67%), *Enterococcus spp* (8.33%), *S.aureus* (8.33), and *Candida spp* (8.33%). Sensitivity pattern of Acinetobacter spp was depicted in figure 1. Bacteria causing blood stream infections and belonging to the family Enterobacteriaceae showed high level resistance to Amoxycillin-clavulanate, Aminoglycosides, 3rd generation Cephalosporin, Doxycycline and to Meropenem with resistance rate being 72% each. Ciprofloxacin were practically of no use with 100% resistance rate. Whereas the only drug having high sensitivity was Polymixin B with 100% sensitivity against these isolates. Among the gram positive isolates causing blood stream infections, all isolates showed high level of resistance to Amoxycillin-clavulanate, Roxithromycin, Clindamycin, Chloramphenicol and Aminoglycosides with resistance rates being 75% each. Ciprofloxacin and 3rd generation Cephalosporin showed 100% resistance against these isolates. All isolates were sensitive to Vancomycin but Linezolid showed 75 % sensitivity with 1 isolate of CONS showing resistance to Linezolid. Among the gram positive isolates both the 2 strains of *Staphylococcus aureus* were methicillin resistant (MRSA) strain.

Bacteria causing pneumonia and belonging to the family Enterobacteriaceae showed high degree resistance to Aminoglycosides (82%), third generation Cephalosporins, Doxycycline, and Trimethoprim-sulphamethoxazole, resistance rate being 94%, each. Ciprofloxacin, Amoxycillin-clavulanate, were practically of no use against these isolates with 100% resistance rate. Carbapenems like Meropenem was only 35% sensitive and Levofloxacin 24% sensitive. Piperacillin-Tazobactum combination was 76% resistant. Whereas the only drug having high sensitivity was Polymixin B with 100% sensitivity against these isolates. *Pseudomonas spp* causing pneumonia in ICU showed high level resistance to Aminoglycoside, Meropenem and 3rd generation Cephalosporin, with resistance rate being 80%, 53%, 84% respectively. All the isolates (100%) were resistant to Quinolones and Trimethoprim-sulphamethoxazole. Polymyxin B however showed 100% sensitivity against these isolates.
The most common causative agent of UTI was *Escherichia coli* (33.34%), followed by *Klebsiella spp* (16.67%). Fig 2 showed the sensitivity pattern of the common isolates which predominantly belongs to Enterobactericeae family.

Table 1. Distribution of various samples with culture results

Type of sample	Culture results			
	Culture positive		Culture negative	
	NO.	%	NO.	%
Blood (n=51)	21	41.17	30	58.83
Respiratory samples(n=34)	30	88.23	4	11.77
Urine (n=28)	12	42.85	16	57.15
Pus (n=7)	7	100	0	0

$\chi 2=21.05$ df=2 p=.0000208

Table 2. Age wise distribution of patients and results of culture

Age (in years)	Culture results			
	Culture positive		Culture negative	
	Number (n)	Percentage (%)	Number (n)	Percentage (%)
<20 (n=14)	7	50	7	50
20-40(n=44)	25	56.82	19	43.18
41-60(n=37)	20	54.05	17	45.95
>60 (n=25)	18	72	7	28

Table 3. Distribution of various samples with results of culture

Length of stay	Culture result			
	Culture positive		Culture negative	
	Number	Percentage (%)	Number	Percentage (%)
≤ 3 days	5	23.81	16	76.19
3-6 days	24	57.14	18	42.86
≥ 7 days	41	71.92	16	28.08

$\chi 2=21.05$ df=2 P value =.0000208

Table 4. Distribution of various in-situ devices among patients of ICU with result of culture

In-situ devices	Culture result			
	Culture positive		Culture negative	
	NO.	%	NO.	%
Central venous line and urinary catheterization (n=18)	12	66.66	6	33.34
Peripheral venous line and urinary catheterization (n=35)	13	37.14	22	62.86
Endotracheal intubation, central venous line and urinary catheterization (n=23)	17	73.93	6	26.09
Endotracheal intubation, peripheral venous line and urinary catheterization (n=44)	28	63.63	16	36.37

$\chi 2=9.79$ df=3 p=.020

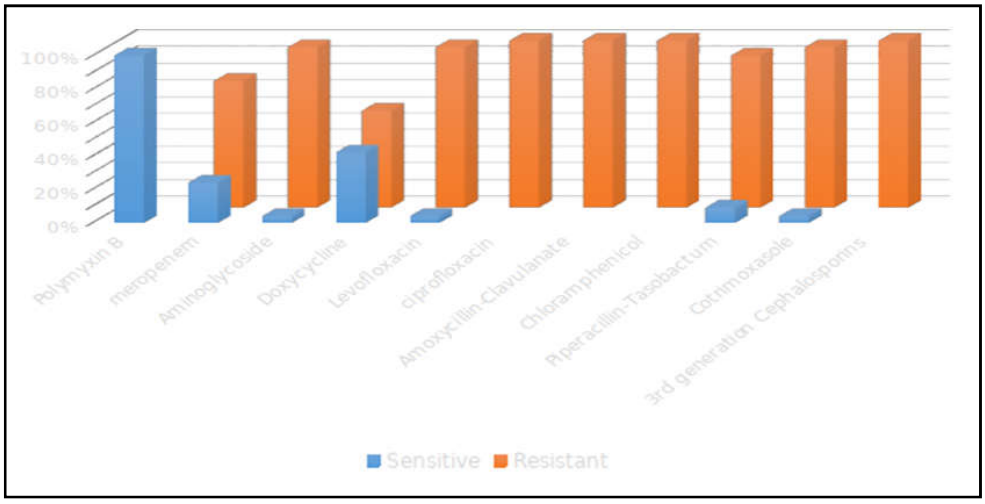

Fig. 1. Clustered cylinders showing antimicrobial sensitivity pattern of *Acinetobacter spp.* from various sample

Gram negative bacilli causing wound infections and belonging to the family Enterobacteriaceae showed high level resistance to Amoxycillin-clavulanate, Doxycycline, 3rd generation Cephalosporin and Meropenem with resistance rate being 80%, 80%,80%, and 60% respectively. All the isolates (100%) showed resistance to Aminoglycoside, Ciprofloxacin and Trimethoprim-sulphamethoxazole. However 100% isolates showed sensitivity to Polymixin B.

DISCUSSION

HAI have been associated with substantial morbidity, mortality and increased health care costs. ICU associated infections and its antimicrobial resistance is considered a serious problem worldwide. The present study was undertaken to determine the epidemiology of HAI among adult patients admitted in ICU in our hospital.

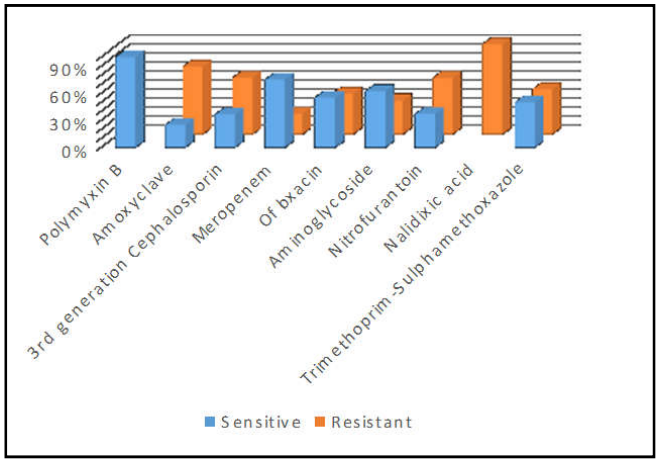

Fig. 2. Antimicrobial sensitivity pattern of Enterobacteriaceae causing UTI in ICU

Out of the total 120 samples included in our study, 70 (58.33%) showed growth of pathogens and two samples yielded growth of two organisms, and one sample yielded growth of three organisms, so total 74 isolates were processed and their results were analyzed. Though the rate of ICU-acquired infections varying it was found that the rate of infection was significantly higher in our set-up (56.25%), much higher than the rate of infection studied by Buke *et al* in a Turkish Neurological ICU in 2009 [13], Zolldann *et al*[14] where rate of HAI was 30.8%, 18.5% and respectively. Age of the study subjects were evaluated as a factor for association with infection. In the present study, 23.81 % of subjects with duration of stay in ICU less than 3 days showed culture positivity whereas culture positivity was 71.92% among those having length of stay in ICU for >7 days. This association was statistically analyzed and it was statistically significant. ($\chi 2$=14.7 df=2 p=.001) [Table 2]. Datta *et al*[15] in her study found length of ICU stay ≥8 days to be significantly associated with health-care-associated infections.(p <.05). Meric *et al* [16] found length of stay in ICU for >7 days a significant risk factor for infection. (Odds ratio [OR]: 7.02; 95% confidence interval [CI]: 2.80-17.56).

Presences of various invasive devices in study subjects were associated with HAI. This association was found to be statistically significant ($\chi 2$=9.79 df=3 p=.020) in our study. In the study done by Meric *et al* [16] in 2005 in a Turkish hospital, intubation (OR: 3.60; 95% CI: 1.05-12.39) and central venous catheterization (OR: 7.85; 95% CI: 1.61-38.32) were found to be significant risk factors for infection. Pellizer *et al* [17] in a study in an Italian hospital found presence of central venous catheter >24 h, urinary catheter, intubation to be significant risk factor for infection. Types of infections occurring in our ICU set up were evaluated. Pneumonia (43%) was found to be most common infections in the ICU of our set-up followed by blood stream infections (30%), urinary tract infections (17%), and wound infections (10%). According to nationwide infection surveillance systems based on voluntary participation and reporting of infections, such as the National Nosocomial Infection Surveillance System (NNIS) in USA the incidence of infection in mixed medical-surgical ICUs varied from 13.8% to 35%, and respiratory tract has typically been the most prevalent site of infection (25%–45%), followed by BSIs (12%–32%) and UTIs (10%–28.7%). The findings of the present study were consistent with this study. There were two large studies- a large European one-day prevalence study (EPIC) in 1992 and a similar study from 254 ICUs in Mexico in 2000 and the distribution of ICU-acquired infections in those studies were pneumonia (46.9% in EPIC vs. 39.7% in Mexican study),urinary tract infection (UTI) (17.6% vs. 20.5%) and bloodstream infection (BSI) (12% vs. 3.6%). (Mehta, 2007). In this study, predominant organisms isolated were *Acinetobacter spp*. 21 (28.37%), followed by *Klebsiella spp*., *E.coli*, *Pseudomonas spp*., *S.aureus*, *Proteus spp, Enterobacter spp* and *Candida spp*. was 3 (4.05%). Coagulase negative *staphylococci*(CONS) was 2 (2.74%) and *Enterococcus* spp was 2 (2.27%). These findings were comparable to the observation of Mumtaz *et al* studies, where the predominant organism was *Acinetobacter spp* (24%), followed *Klebsiella* species and *Pseudomonas aeruginosa*. Whereas, a study conducted in 12 ICU's in seven Indian cities showed Enterobacteriaceae (46%), *Pseudomonas* (27%), *Acinetobacter spp.* (6%), *Candida spp.* (8%), *S.aureus* (6%) as causative agents of nosocomial infections.[19].

In one study from Eastern Mediterranean Health Journal, *E.coli* isolates was 14%1. Another study in ICU at Birdem also showed growth obtained from 34% of the samples yielding 632 organisms with major organism isolates as *Pseudomonas spp* (Tullu, 1998). But in a European ICU, *Staphylococcus aureus* was as the most frequently isolated organisms (30.1) followed by *Pseudomonas aeruginosa* (28.7) (Orsini, 2012). Various aerobic bacteria causing blood stream infections were identified in the present study. *Acinetobacter spp* (42.85%) was found to be the most common bacteria causing blood stream infections in our set-up. A nationwide surveillance study conducted in 49 hospitals in USA showed a large prevalence of Gram-positive bacteria causing BSI's compared with Gram-negative organisms. The findings of the present study were also different from the study by Orsini *et al* [22] in USA in 2010, where they found 59% Gram-positive bacteria 31.1% Gram-negative organisms, and 9.8% fungi caused BSI. Among the Gram-positive isolates, the most common organism identified was CoNS (38.8%) and most common Gram-negative bacteria isolated were *Klebsiella* (26.3%). *Acinetobacter spp.* (40%) was found to be the most common bacteria causing pneumonia in our ICU set-up. Other organisms causing pneumonia were, *Klebsiella spp*, *Pseudomonas spp*, *Escherichia coli*, *S.aureus*, and *Candida spp*. In a study from central India by Bajpai *et al* (Kombade, 2014), found bacteria causing pneumonia were 96.05% Gram-negative and 3.95% were Gram-positive bacteria.

The most prevalent Gram-negative pathogen was *Pseudomonas aeruginosa*, (33.20%) followed by *Klebsiella spp* (31.22%) while the most prevalent Gram-positive pathogen was *Staphylococcu aureus* (3.55%) followed by *Streptococcus spp.* (0.39%). In another study by Kombade *et al* (Laupland, 2005) from India in 2010 found *Pseudomonas aeruginosa* (23.8%) were the commonest isolate obtained. The percentage of different organisms was slightly different from the present study. According to the Infectious Disease Society of America (IDSA) guidelines, the most common pathogens causing UTI are predominantly those belonging to the Enterobacteriaceae family with Escherichia coli being the most common micro-organism followed by *Klebsiella spp*, *Enterobacter spp*, *Proteus spp* and *Citrobacter spp*. Besides the Enterobacteriaceae family, the other organisms responsible are *Pseudomonas aeruginosa*, *Enterococci spp*., Staphylococci spp. These guidelines however state that infecting organisms also depend on the hospital setup. In ICU settings, the most common organisms

isolated may be Gram negative organisms, *Enterococci spp* and *Pseudomonas aeruginosa*. The present study had an similar observation too where the most common organism were from the Enterobacteriaceae forming 66.66 % of the isolates and *Escherichia coli* was the predominant pathogen isolated. In a study by Laupland *et al*. (Marra, 2011) in Canada, the findings were slightly different with organisms causing UTI in ICU were *Escherichia coli* (23%), Candida albicans (20%), *Enterococcus species* (15%), *Pseudomonas aeruginosa* (10%), *Klebsiella Pneumonia* (5%), Coagulase negative *staphylococcus* (5%), *Proteus mirabilis* (5%), *Enterobacter spp*. (3%). In the present study isolates of *Acinetobacter spp.* from various samples were highly resistant to Amoxycillin-clavulanate, Ciprofloxacin, Chloramphenicol, third generation cephalosporins with resistance rate being 100% each. In the other hand doxycycline and meropenem showed only 42% and 24% sensitivity respectively. Whereas the only drug having high sensitivity was Polymixin B with 100% sensitivity against all these isolates.

Bacteria causing blood stream infections and belonging to the family Enterobacteriaceae showed high level resistance to Amoxycillin-clavulanate, Aminoglycosides, 3rd generation Cephalosporin, Doxycycline and to Meropenem with resistance rate being 72% each. Ciprofloxacin were practically of no use with 100% resistance rate. Whereas the only drug having high sensitivity was Polymixin B with 100% sensitivity against these isolates. Among the gram positive isolates causing blood stream infections, all isolates Gram positive isolates showed high level of resistance to Amoxycillin-clavulanate, Roxithromycin, Clindamycin, Chloramphenicol and to Aminoglycosides with resistance rates being 75% each. Ciprofloxacin and 3rd generation Cephalosporin showed 100% resistance against these isolates. All isolates (100%) were sensitive to Vancomycin but Linezolid showed 75 % sensitivity with 1 isolate of CONS showing resistance to Linezolid. Among the gram positive isolates both the 2 strains of *Staphylococcu aureus* were MRSA and were resistant to cefoxitin (100%). In a study by Marra *et al.* (Goel, 2009) from 16 Brazilian hospitals showed that cephalosporins, aminoglycosides, fluoroquinolones, and carbapenems were not active against >50% of the isolates of *Acinetobacter spp*. tested. Relatively high proportions of *Klebsiella spp*. displayed resistance to ampicillin-sulbactam, piperacillin-tazobactam, ceftazidime, and cefepime (54.5%, 33.5%, 54.4%, and 50.2%, respectively).

But resistance to meropenem was seen in only 1.3% of the isolates which is much less than our finding. Methicillin resistance was detected in 43.7% of *S.aureus* isolates. Vancomycin resistance was found in 25% isolates of *Enterococcus*. The findings of the present study were also different from the study by Orsini *et al*. (Bajpai, 2013) in USA in 2010,where they found among the Staphylococcal isolates 40% were MRSA, Among the *Enterococcus spp,* 66.6% were resistant to Vancomycin (VRE). 34.2% Gram-negative organisms were identified as MDR and Carbapenem-resistant phenotype was found in 75% of gram negative isolates: among which 55.5% were *Klebsiella Pneumoniae*, and 44.4% were *Acinetobacter baumannii*. This finding was lower from the present study where resistance rate to meropenem against all gram negative strains isolated from blood samples are 92%. Bacteria causing pneumonia and belonging to the family Enterobacteriaceae showed high degree of resistance to Aminoglycosides (82%).3rd generation Cephalosporins, Doxycycline, and Trimethoprim-sulphamethoxazole were highly resistance rate being 94%, each. Ciprofloxacin, Amoxycillin-clavulanate, were practically of no use against these isolates with 100% resistance rate. Carbapenems like Meropenem was only 35% sensitive and Levofloxacin 24% sensitive. Piperacillin-Tazobactum combination was 76% resistant. Whereas the only drug having high sensitivity were Polymixin B with 100% sensitivity against these isolates. *Pseudomonas spp* causing pneumonia in ICU showed high level resistance to Aminoglycoside, Meropenam and 3rd generation Cephalosporin, with resistance rate being 80%, 53%, 84% respectively. All the isolates (100%) were resistant to Amoxycillin-clavulanate, Quinolone, and Trimethoprim-sulphamethoxazole and Ciprofloxacin. Polymyxin B however showed 100 % sensitivity against these isolates. One gram positive cocci isolated from respiratory samples, (100%) was sensitive to Vancomycin and Linezolid whereas (100%) was resistant to Ciprofloxacin, Amoxycillin-clavulanate, chloramphenicol and 3rd generation Cephalosporins. The findings of the present study were similar to study of Goel *et al* in 2009 in India, where they observed 80-100% resistance in all gram negative isolates to ciprofloxacin, 3rd gen cephalosporin, co-trimoxazole, and amoxycillin/clavulanic acid combination. The findings of another study by Bajpai *et al* [23] in 2013 from central India were slightly dissimilar from the present study. They found high rates of resistance to cephalosporins (75.38%) by all the Gram-negative bacteria. The resistance rates for carbapenem were 24.9% followed by aminoglycosides (39.5%).these resistance rates were much higher in the present study.

The percentage susceptibility of *S.aureus* towards vancomycin and linezolid was 100% which was similar to the present study findings. Bajpai *et al* found MRSA accounted for 55.55% of nosocomial *S.aureus* infections, which was lower than our study. Gram negative organisms isolated from urine samples and belonging to Enterobacteriaceae family showed high level resistance to Amoxycillin- Clavulanate, Nitrofurantoin and Ofloxacin with resistance rate being 75%, 62.5%, 45% respectively. All the isolates (100%) were resistant to Nalidixic Acid. Isolates showed good sensitivity to Polymyxin B, Meropenam and Aminoglycosides. The single strain of *Enterococcus* spp. isolated from urine samples showed sensitivity to Linezolid but was resistant to Vancomycin (VRE). Sotto *et al.* (Bi, 2009), found a resistance of 2.5% in the *E.coli* isolates to second generation cephalosporins, 0.3% to third generation cephalosporins, 0% to imipenem and cefepime and 23.5% to cotrimoxazole. The reason for this low resistance could be that their study was carried out in a developed country in the West where strict adherence to infection control practices is followed. A study by Bi XC *et al.* (Taiwo, 2006) found a resistance of 62.3% to cefazolin among isolates of *E.coli*, 78.3% to amoxicillin and 82.9% to ampicillin. Taiwo *et al.* in their study found high resistance i.e. 100% to aminoglycosides, 81.8% to cotrimoxazole, 61.5% to nitrofurantoin, 53.8% to Colistin and 100% to fluoroquinolones. Gram negative bacilli causing wound infections and belonging to the family Enterobacteiaceae showed high level resistance to Amoxycillin-clavulanate, Doxycycline, 3rd generation Cephalosporin and Meropenam. All the isolates (100%) showed resistance to Aminoglycoside, Ciprofloxacin and Trimethoprim-sulphamethoxazole. However 100% isolates showed sensitivity to Polymixin B. This pattern of antibiotic sensitivity correlates with the study of Anvikar *et*

al who has reported that the organisms responsible for wound infection are resistant to the commonly used antibiotics.

Conclusion

HAI affect a vast majority of patients, especially those admitted in the ICU. Majority of these infections are related to the use of devices which have become indispensable in modern care. In the present study, significant association of HAI was found between increased length of stay in the ICU and presence of invasive devices. Also the most emerging problem today is the resistance of this pathogens causing HAI to higher antibiotics. So injudicious use of antibiotics must be curbed and each hospital should have one antimicrobial policy based on the epidemiology of the HAI causing pathogens. So, it can be concluded that length of stay in the ICUs, minimized use of in-situ devices and judicious use of antimicrobials is the key to reduce the burden of HAI. Regular surveillance of these infections is an essential step in the infection control and quality care assurance to patients.

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