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ANTIMICROBIAL RESISTANCE PATTERN OF BACTERIA ISOLATED FROM ICU PATIENTS WITH URINARY TRACT INFECTIONS

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ABSTRACT

This study has assessed the resistance pattern of common respiratory pathogens among the hospitalized ICUs patients. A total number of 51 clinical samples were collected of which 33 (64.71%) were from male and 18 (35.29%) were from female. Out of 51 samples, 45 (88.24%) samples yielded growth while no bacterial pathogen was isolated from rest 6 (11.76%) samples. The common infecting organisms isolated in this study were *Staphylococcus aureus* (n=27, 36.98%) and *Pseudomonas aeruginosa* (n=27, 36.98%), followed by *Staphylococcus epidermidis* (n=10, 13.69%), *Salmonela enterica* (n=5, 6.85%), *Serrata marcescens* (n=1, 1.37%), *Klebsiella pneumoniae* (n=1, 1.37%), *Staphylococcus saprophyticus* (n=1, 1.37%), *Enterobacter aerogenes* (n=1, 1.37%). Most of the isolates were 100% resistant to Penicillin, Ceftazidime, Ceftriaxone, Tetracycline, Cotrimoxazole and Piperacillin. *Pseudomonas aeruginosa* and *Staphylococcus aureus* show good sensitivity to all of the examined antibiotics. More specifically, *Pseudomonas aeruginosa* showed 100% sensitivity to Levofloxacin, Nalidixic acid, Cefotaxim, Piperacillin and Ceftriaxone.

KEYWORDS: Antimicrobial resistance, ICU patients, urinary tract infection

INTRODUCTION

Nosocomial infections are usually defined as infections that are identified at least 48–72 hours following admission to health institutions. Nosocomial infections are also important public health problems in developing countries as well as in developed countries. The most frequent types of Nosocomial infections are urinary tract infection (UTI), surgical-wound infection, pneumonia, and bloodstream infection (BSI). BSIs are responsible for approximately 10–30% of the cases. UTI is the presence of bacteria in the urine (bacteriuria) and defined as the growth of a single pathogen of $>10^5$ colony-forming units/mL from properly collected mid-stream urine specimens. The common bacterial pathogens present in the BSIs and UTIs are *Staphylococcus aureus,* Coagulase-Negative *Staphylococci* (CoNS), *Pseudomonas aeruginosa, Klebsiella pneumoniae, Escherichia coli, Enterobacter spp., Enterococcus spp.,* and *Acinetobacter spp* . As the result of extensive uses of antimicrobial agents, nosocomial pathogens have shifted away from easily treatable bacteria towards more resistant bacteria. [1]

The incidence of nosocomial infections in ICU is 4-5 times greater than in general ward. Critically ill patients are always at higher risk of developing nosocomial infections with resistant strains.

Antimicrobial resistance among intensive care unit (ICU) pathogens is generally increasing, but variations do exist among different countries, probably due to individual antimicrobial use patterns. When new medical practices and alternative antimicrobials are introduced, changes in the dominant microbial etiologies may emerge prompting novel empiric selections. Appropriate therapy of ICU infections directed by local resistance data can have significant consequences for both patient and the healthcare system.

Data from National Nosocomial Infections Surveillance (NNIS) shows that from 1988 to 1995

the number of intensive care unit (ICU) beds at the hospitals has increased 17%, whereas total hospital bed capacity decreased slightly. Patients receiving care in ICUs are at high risk for nosocomial infections. The emergence of antimicrobial-resistant pathogens in ICUs has made treating these infections very difficult and, in some cases, impossible. Intensive care unit patients are particularly susceptible to nosocomial infections due to underlying illnesses, suppressed immune systems and frequent use of invasive devices. [2]

Globally, patients in the ICU have encountered an increasing emergence and spread of antibiotic-resistant pathogens. The worldwide incidence rate is 23.7 infections per 1 000 patient days. Rates of nosocomial infections range from 5% to 30% among ICU patients. Although ICUs generally comprise < 5% of all hospital beds, they account for 20% to 25% of all nosocomial infections. The increased risk of infection is associated with the severity of the patient's illness, length of exposure to invasive devices and procedures, increased patient contact with healthcare personnel and length of stay in the ICU. [2]

With the increased use of invasive procedures, at least 8% of patients acquire nosocomial infections. Nosocomial infections increase the cost of medical care, extend the duration of hospital stay, and affect the morbidity and mortality of the admitted patients. The health care providers are also at risk of acquiring nosocomial infections and add the functional disability to the health care system. [3]

This study reviews the pathogens associated with nosocomial infections among ICU patients of some hospitals in Bangladesh. It also summarizes the rates of antimicrobial resistance in the most common pathogens. The purpose of this study is to demonstrate the present condition of antimicrobials' effect on infections in our country. Thus we can have an idea about the measures to be taken against these resistant microorganisms.

MATERIALS AND METHODS

From the period of June 2014 to August 2014, 51 urine samples were collected from ICU patients of 4 hospitals in Dhaka city, Japan Bangladesh Friendship Hospital (JBFH), Kidney General Hospital (KGH), City Hospital (CH) and Dhaka Medical College (DMC) Hospital.

Collected samples were aseptically transferred to the laboratory, cultured in fresh Nutrient Agar Media plates and were incubated within 24 hours of their collection. After incubating for 24 hours at 37°C, cultures were stored at 2-8°C for further examinations.

Identification test of isolated organisms: To identify the isolated organisms, selective media were used. Such as, MacConkey Agar was used to identify *Klebsiella pneumoniae, Salmonella enterica, Serratia marcescens;* Mannitol Salt Agar for *Staphylococcus aureus, Staphylococcus epidermidis, Staphylococcus saprophyticus, Enterobacter aerogenes;* Cetrimide Agar for *Pseudomonas aeruginosa and* Mueller Hinton for *Staphulococcus aureus, Klebsiella pneumoniae.*

Biochemical test: Biochemical tests, Catalase test, Triple Sugar Iron agar test and Citrate utilization tests were done to identify the isolated microorganisms more specifically.

Antibiotic susceptibility test: Antibiotic susceptibility test of isolates on 23 commonly used antibiotics were performed on freshly made Muller-Hinton agar medium by disk diffusion technique according to National Committee for Clinical Laboratory Standards (NCCLS) modified Kirby-Bauer disc diffusion technique.[4] Disc of antibiotics such as Ceftazidime(30µg), Cephalexin(30µg), Cefotaxime(30µg), Ceftriaxone(30µg), Piperacillin (100µg), Amoxicillin(30µg), Penicillin(10µg), Cloxacillin(1µg), Nalidixic acid(30µg), Ciprofloxacin(5µg), Levofloxacin (5µg), Streptomycin (25µg), Gentamycin(10µg), Amikacin (30µg), Neomycin(30µg), Azithromycin (30µg), Erythromycin (15µg), Chloramphenicol(30µg), Tetracycline (30µg), Vancomycin(30µg), Colistin(50µg), Imipenem(10µg) and Cotrimoxazole (25µg) are placed on each isolate cultures respectively and incubated at 37°C. After 24 hours of incubation, the diameter of zone of inhibition surrounding the antibiotics was measured and result was constructed according to NCCLS. [4]

RESULTS AND DISCUSSION

All the laboratory test results were assessed carefully and these results present the recent situation of antimicrobial resistant pattern of commonly found bacteria in the ICU patients.

This study was conducted among the 51 hospitalized ICU patients of DMC, CH, KGH and JBFH of Dhaka city. Among 51 clinical samples, 88.24% were positive cases of bacterial infection. Study shows, 30 male patients (n=30, 58.82%) were infected among 33 male patients (n=33, 64.71%) and 15 female patients (n=15, 29.41%) were infected among 18 female patients (n=18, 35.29%) which is lower than male infected number (Figure 1).

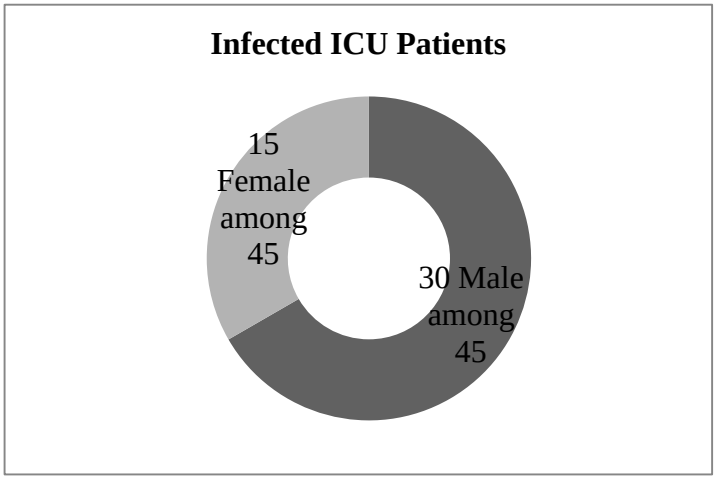

Figure 1: Number of infected male and female samples of ICU patient

A study done with 904 ICU patients, during May 2007-May 2008, showed 56.1% (105 cases) were male patients and 43.9% (82 cases) were female. [5] In that study, the higher number of infected people was from male patient group which was higher in our study also.

Total 51 samples were collected from 4 different hospitals' ICU departments. Out of 51(100%) samples, 45 (88.24%) samples yielded growth, and among these 45 growth proven samples, 31 (n=32; 96.88%) samples belonged to DMCH, 10 (n=10; 100%) samples were from CH, 3 (n=6; 50%) samples were from KGH and 1(n=3; 33.33%) sample was from JBFH (Figure 2).

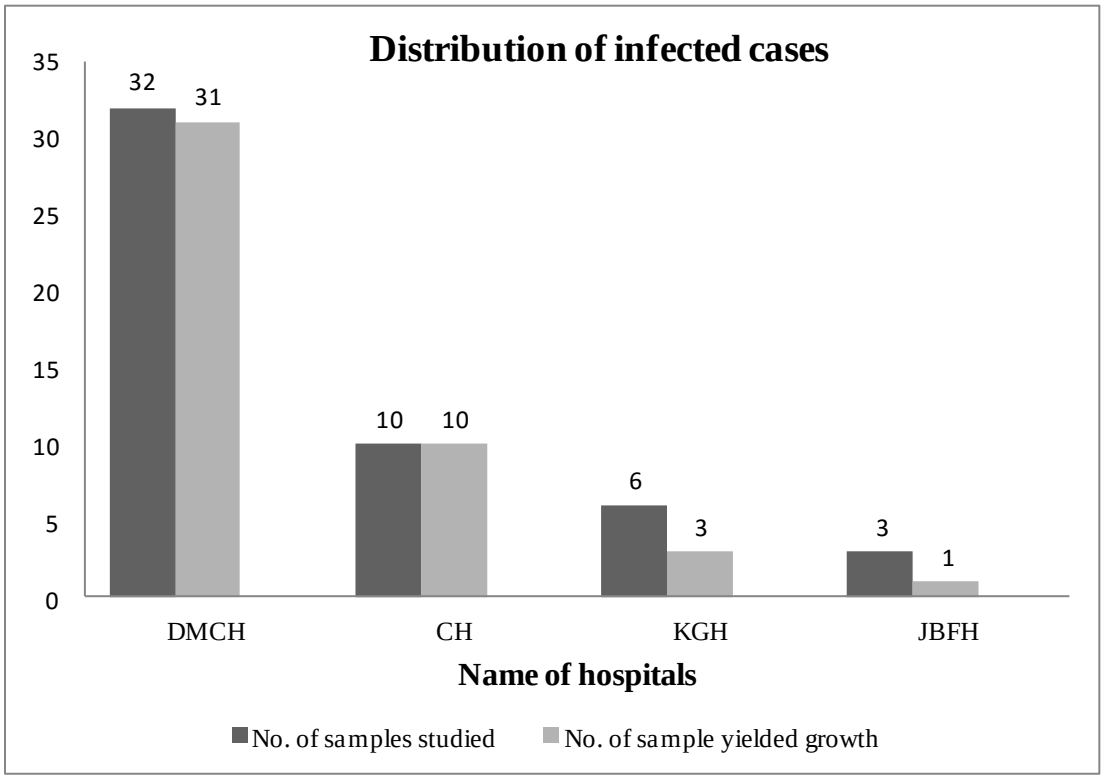

Figure 2: Distribution of infected cases in different hospitals

The common infecting organisms isolated in this study were *Pseudomonas aeruginosa* (36.98%) and *Staphylococcus aureus* (36.98%), followed by *Salmonella enterica* (6.85%), *Staphylococcus epidermidis*(13.69%), *Serratia marcescens* (1.37%), *Klebsilla pneumoniae* (1.37%), *Staphylococcus saprophyticus* (1.37%) and *Enterobacter aerogenes* (1.37%) (Figure 3).

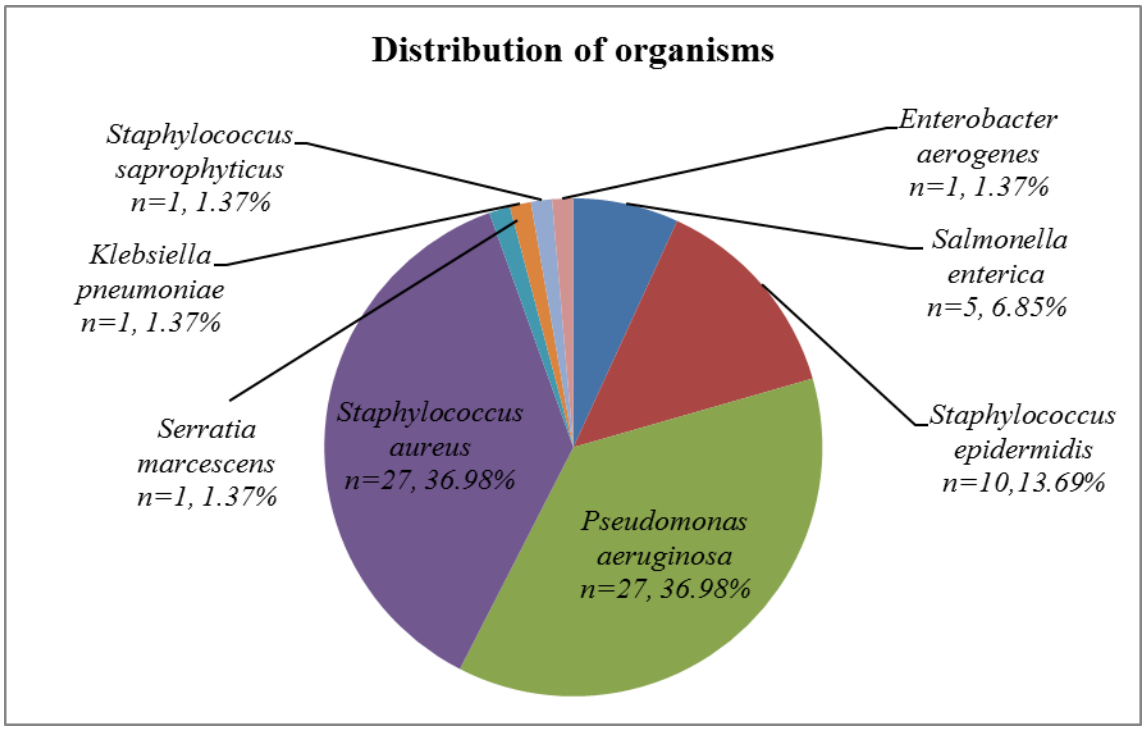

Figure 3: Distribution of organisms isolated from different samples of ICU patients

A study conducted among 500 specimens from ICU patients gave evidence of *Pseudomonas aeruginosa* (43.2%), *Klebsiella spp* (33.7%) and *Staphylococcus aureus* (39.2%). [6] Another study revealed that, in total 135 nosocomial infections, the most frequently isolated organism was *P. aeruginosa* (25%), followed by *S. aureus* (21.4%), *E. coli* (18.7%) and *A. baumannii* (16.9%).[7] Findings of our study resemble both the studies in the fact that, *P. aeruginosa* and *S. aureus* are the leading organisms behind Nosocomial infections in recent time.

Figure 4 to 7 demonstrated the antimicrobial resistance pattern of isolated organisms. Most of the isolates were 100% resistant to Penicillin, Ceftazidime, Ceftriaxone, Tetracycline, Cotrimoxazole and Piperacillin.

Figure 4 stated that except *Pseudomonas aeruginosa*, most of the isolates were resistant to Ceftazidime, Cephalexin, Cefotaxim and Cefriaxone. It was 100% sensitive to Cefotaxim and Cefriaxone. Cefotaxim was sensitive for *Salmonella enterica* and *Klebsiella pneumoniae* also.

Figure 5 showed *Pseudomonas aeruginosa* was quite sensitive to some penicillin group drugs followed by *Staphylococcus aureus*. Figure 6 demonstrates that *Klebsiella pneumoniae* was 100% sensitive to Amikacin and Ciprofloxacin. *Pseudomonas aeruginosa* was less resistant to all the antibiotics compared to other organisms and it was 0% resistant to Levofloxacin and Nalidixic acid.

Figure 7 (a) and 7 (b) showed no result of sensitive organism, other than *Klebsiella pneumoniae.* It showed 100% sensitivity to Azithromycin, Erythromycin, Colistin and Imipenem. Compared to other organisms, *Pseudomonas aeruginosa* and *Staphylococcus aureus* possessed less resistance to all the antibiotics showed in Figure 7 and 8.

Over all, it can be said that, *Pseudomonas aeruginosa* and *Staphylococcus aureus* showed good sensitivity to all of these antibiotics. More specifically, *Pseudomonas aeruginosa* showed 100% sensitivity to Levofloxacin, Nalidixic acid, Cefotaxim, Piperacillin and Ceftriaxone.

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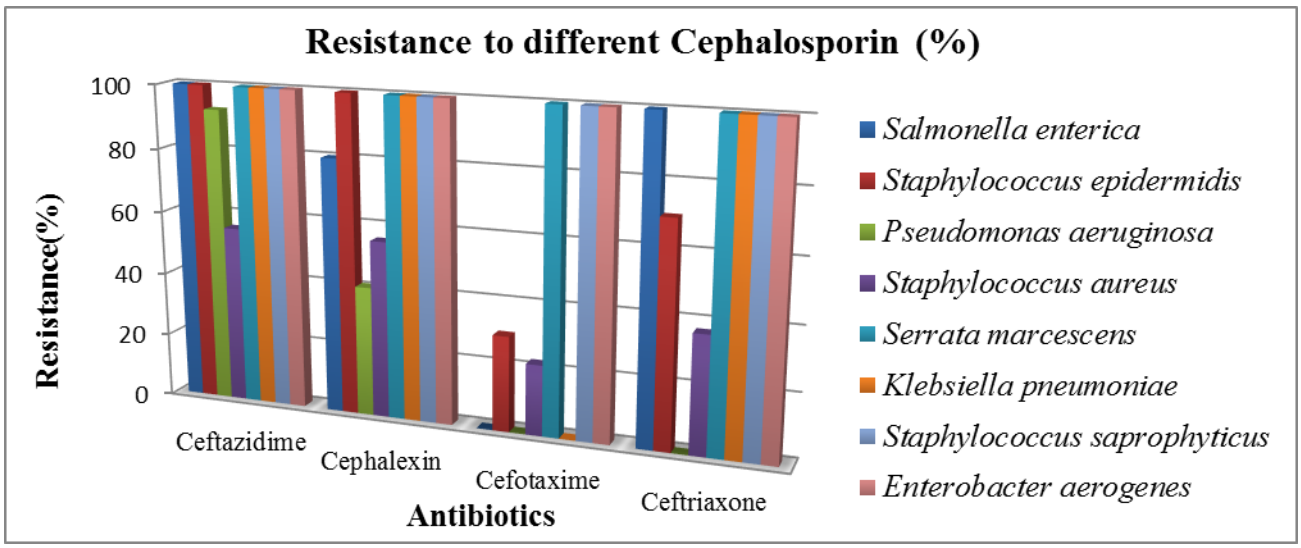

Figure 4: Antimicrobial (Cephalosporin) resistance pattern of isolated pathogens from ICU

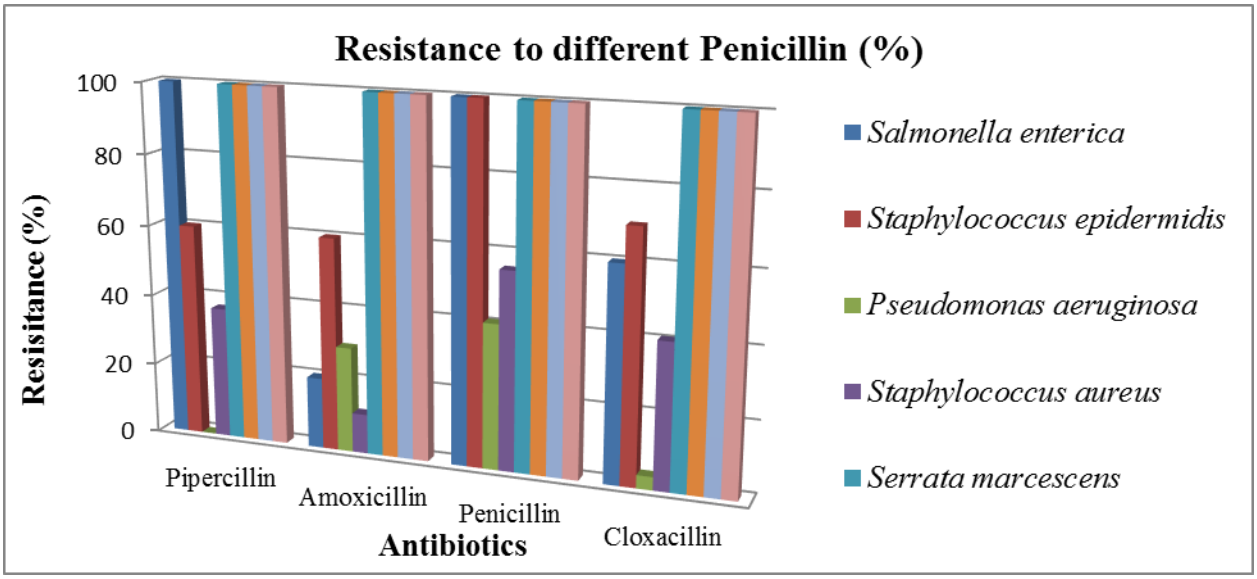

Figure 5: Antimicrobial (Penicillin) resistance pattern of isolated pathogens from ICU

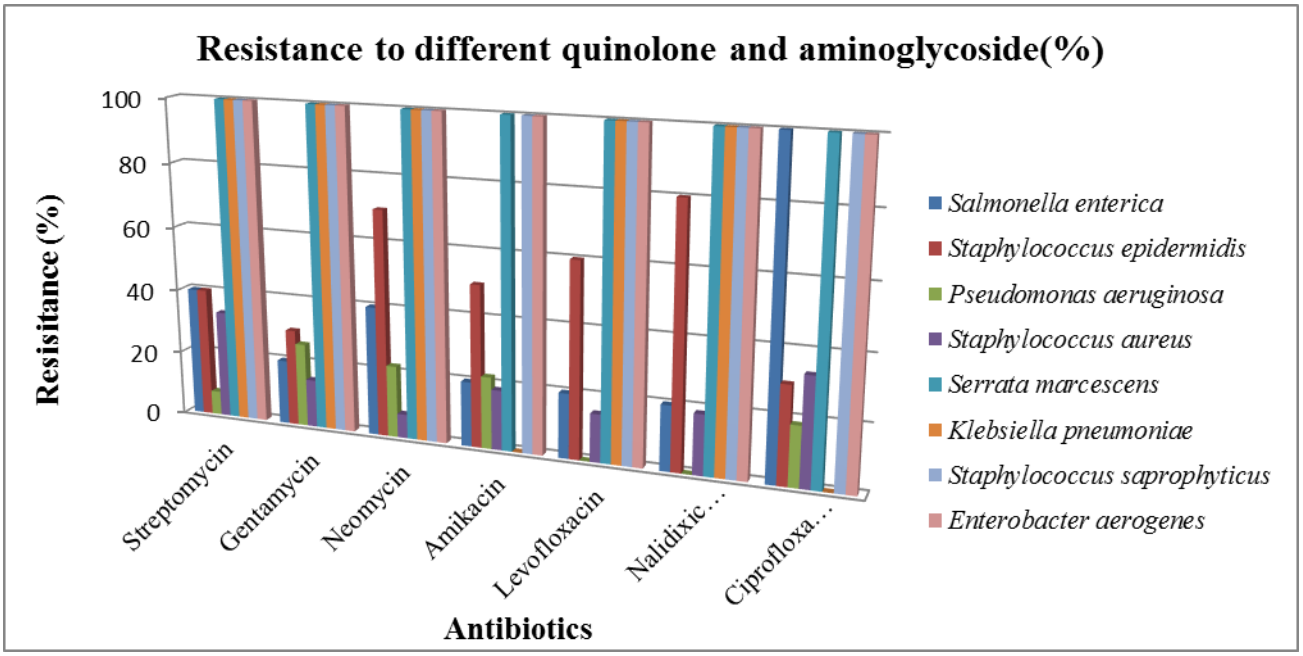

Figure 6: Antimicrobial (quinolone and aminoglycoside) resistance pattern of isolated pathogens from ICU

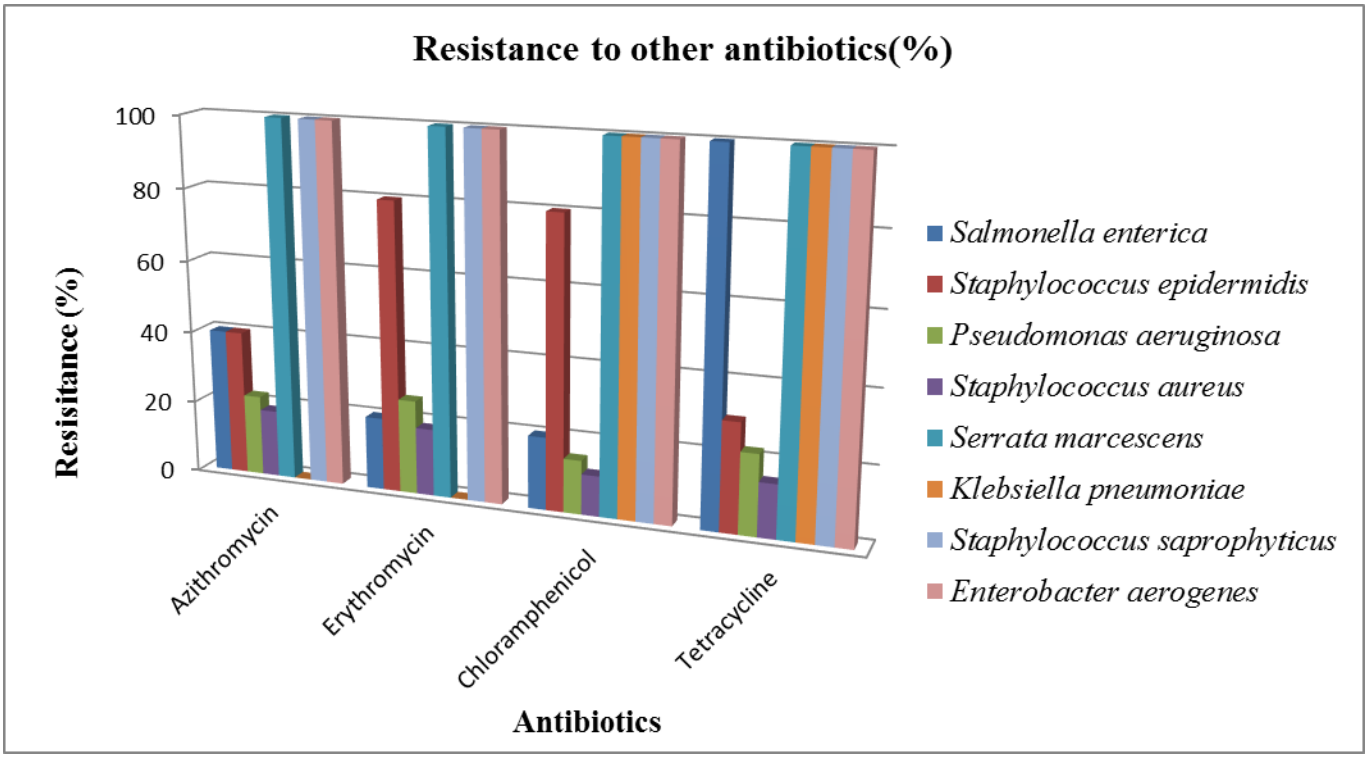

Figure 7 (a): Antimicrobial resistance pattern of isolated pathogens from ICU

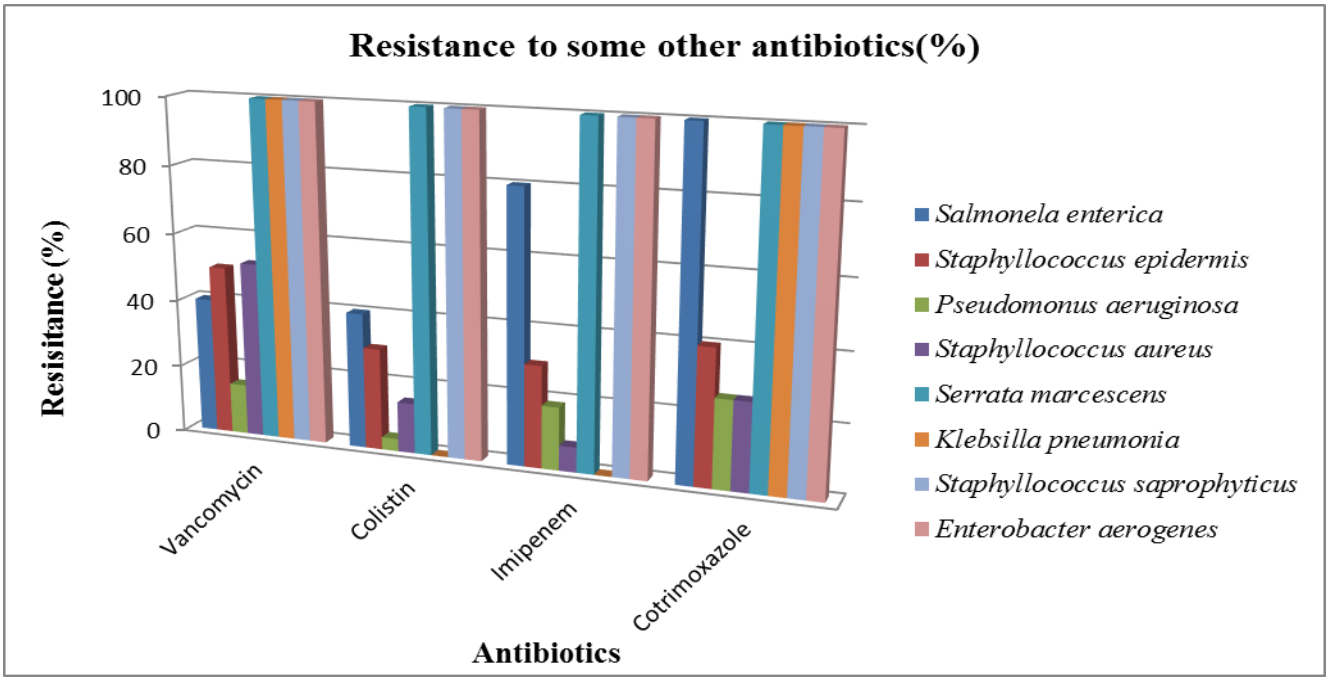

Figure 7 (b): Antimicrobial resistance pattern of isolated pathogens from ICU

A cross sectional study was held with 500 specimens from ICU patients having nosocomial infection. In that study, Amikacin and Imipenem were the most active antibiotics against gram-negative microorganisms (54% and 46% respectively). [6] Similarly the present study, these two drugs showed less resistance to most of the organisms found. Above mentioned study also analyzed that, Staphylococcus species were sensitive to Vancomycin (83.3%) and highly resistant to Cloxacillin (96.6%).[6] But in present findings, these organisms showed moderate sensitivity and resistance respectively to Vancomycin and Cloxacillin.

A study conducted in Iran, demonstrated that, the frequency of resistance to antimicrobial agents was 50% to 100% for Ceftriaxone, 50% to 94.1% for Ceftazidime, 52.9% to 63.8% for Ciprofloxacin, 58.3% to 84.5% for Cefepime, 88.33% to 100% for Ampicillin, 58.3% to 100% for Cefotaxime, 60% for Piperacillin- Tazobactam and 50% for Gentamicin.[5] Likewise, the present study also showed resistance to most of the tested antimicrobials. Such as, Ceftriaxone (37.03% to 100%), Ceftazidime (55.55% to 100%), Ciprofloxacin (30% to 100%) and Piperacillin (37.03 % to 100%). But Cefotaxim and Gentamycin were proven to be less resistant for the organisms.

In Iran a study again showed that, the resistance frequency to imipenem was 1.6% for *E. coli* and 3.4% for *K. pnumoniae* and 16.66% for *P. aeruginosa*.[5] Also in the present study, isolates of *Klebsiella spp.*, *Pseudomonas aeruginosa* and *Staphylococcus aureus* proved sensitivity to imipenem.

Another study, again in Iran aimed to evaluate antibiotic resistance profiles in nosocomial bloodstream and urinary tract pathogens. The most prevalent BSI pathogen was Coagulase-Negative *Staphylococci* (CoNS). The highest resistance rate of CoNS was against Penicillin (91.1%) followed by Ampicillin (75.6%), and the lowest rate was against Vancomycin (4.4%).[1] Present study had different findings, where, *Staphylococcus aureus* was one of the major infectious agents and the highest resistance rate was against Penicillin (55.56%), Cephalexin (55.55%), Ceftazidime (55.55%) and Vancomycin (51.85%), and the lowest rate was against Neomycin and Imipenem (7.41%).

The increased prevalence of resistant organisms in ICU, probably reflects lack of proper antibiotic policy. It results in prolonged and indiscriminate use of antimicrobial agent.[8]

CONCLUSION

Treatment of nosocomial infection is becoming difficult due to the increasing trend of antibiotics resistance. Current knowledge on antibiotic resistance pattern is essential for appropriate therapy. Nosocomial infections and antimicrobial resistance in the ICUs are major deterrent to patient's outcome,

increased duration of patient stay as well as expense. Reduction of these, are both challenge and goal for all intensive care units around the world.

Strict infection control measures, like universal precautions and stringent adherence to hand washing practices, formulation and antibiotic policy; Surveillance activities, appointment of infection control practitioners; might be required.

Regular monitoring of the antimicrobial resistance and proper maintenance of antibiotic policy can help to improve this severe health problem.

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