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ASSESSMENT OF RISK FACTORS AND ANTIBIOTIC SENSITIVITY PATTERN IN CATHETER-ASSOCIATED URINARY TRACT INFECTION (CAUTI)

MALINI S*[1], JOSSY A[1], GEORGE AF[1], JIJI M[1], JOSHUA JM[1], MATHEWS SM[1] AND VARGHESE S[2]

1: Department of Pharmacy Practice, Pushpagiri College of Pharmacy, Thiruvalla, Kerala

2: Department of General Medicine, Pushpagiri Medical College Hospital, Thiruvalla, Kerala

***Corresponding Author: Dr. M Malini S: E Mail: malinianil505@gmail.com**

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ABSTRACT

Background: Catheter-associated urinary tract infections (CAUTI) are a serious healthcare-associated infection. Many risk factors are associated with its incidence. The growing antibiotic resistance amongst the uropathogen isolated from CAUTI making difficult for its management. In our study we aimed to identify the agents causing CAUTI and their antibiotic sensitivity patterns as well as to analyse the risk factors associated with CAUTI.

Methods: A Prospective Observational study was conducted in Department of General Medicine, in Pushpagiri Medical College Hospital, Thiruvalla. The study was conducted in 81 CAUTI patients for a period of six months. The study population included patients admitted with complaints of CAUTI who satisfied inclusion and exclusion criteria.

Results: On analysing the patient and catheter related risk factors, age greater than 50 years (24.52%), prolonged duration of catheterisation (23.25%) and diabetes (16.56%) were found to be the significant risk factors associated with CAUTI. The most prevalent uropathogen identified in

our study was *Klebsiella pneumonia* (46.91%) followed by *E.coli* (29.63%). Very high antimicrobial resistance was found in *Klebsiella pneumonia* and *E.coli* species in the present study. There was significant improvement in the overall quality of life(p=0.000) after the implementation of the education programme.

Conclusion: The study findings confirmed that most of the uropathogen isolated from CAUTI are resistant to the commonly used antibiotics. This raises alarms to implement Antimicrobial Stewardship programmes with strict adherence to antibiotic policy to reduce the spread of drug resistant microbes which in turn can lower overall cost of health care.

Keywords: CAUTI, Risk factors, Uropathogen, Antibiotic resistance

INTRODUCTION

The most notable complication associated with indwelling urinary catheters is the development of nosocomial urinary tract infections (UTIs), known as catheter associated UTIs (CAUTIs). These Infections are highly significant due to their high incidence and subsequent economic cost and sequel **[1]**. Catheter associated urinary tract infections constitute 40%-50% of all hospital acquired infections **[2]**. It is defined by the Centres for Disease Control and Prevention (CDC) as "Any urinary tract infection in a patient who had an indwelling catheter in place at the time of or within 48 hours after the catheter is removed" **[3]**. According to the Centers for Disease Control, there is a 2.8-fold increase in the morbidity and death rate as well as a 1-3 day increase in hospital stay associated with CAUTI. The importance of CAUTI with regards to cost is best shown by the CMS (Medicare) data in the United States that estimated the annual cost due to CAUTI was between $340 to $450 Million **[4]**. Sepsis and endocarditis are two more severe complications that can result from CAUTI, and approximately 13,000 deaths are thought to be related to UTIs in healthcare settings annually **[5]**. The efforts undertaken to reduce CAUTI rates include avoiding unnecessary catheterisation, reducing duration of catheterisation, emphasising antiseptic technique for insertion, maintenance of urobag below the waist level, strict adherence to five moments of hand hygiene and using hydrophilic-coated catheters **[5]**.

Despite advances in prevention guidelines, there remains a lack of knowledge concerning the risk factors for CAUTI especially pertaining to the effect of catheter dwell-time on CAUTI development and patient comorbidities **[5]**. CAUTIs are a cause of concern because catheter- associated

bacteriuria comprises a huge reservoir of resistant pathogens in the hospital environment **[6]**. Inappropriate use of antimicrobial agents without proper indication has led to increase in emergence of multi drug resistant uropathogens and therefore increased risk of mortality **[7]**. The growing antibiotic resistance amongst the uropathogen isolated from CAUTI further complicates its management **[6]**. An appropriate and judicious use of antibiotic is recommended to treat CAUTI **[1]**. Microbiological profile and antimicrobial sensitivity pattern of CAUTI vary considerably between regions and time to time **[8]**.

The present study is designed with the aim to determine the bacterial pathogens causing Urinary tract infections (UTIs) in patients with indwelling Urinary Catheter and to study their antibiotic Susceptibility Pattern. The findings of the study will provide knowledge about the susceptibility pattern of the local pathogens which will guide for de-escalation strategy (switching from a broad-spectrum antimicrobial therapy to a narrower spectrum) depending on the microbiological data **[1]**. This will help the clinicians to make a precise decision regarding treatment and management of such infections. The study also evaluates the patient and catheter related risk factors contributing to the urinary tract infection, so that special attention can be given to patients carrying these risk factors. The need of the hour is to implement a nationwide antimicrobial surveillance and in-vitro susceptibility testing with strict adherence to antibiotic policy to inhibit the spread of drug resistant microbes in the country **[7]**.

MATERIALS AND METHODS

The study was single centered, Hospital based, Prospective Observational study. The proposed study was conducted in Department of General Medicine, in Pushpagiri Medical College Hospital, Tiruvalla for a period of six months. The study population included patients admitted with complaints of CAUTI who satisfied inclusion and exclusion criteria and admitted to General Medicine Department. Inclusion criteria were: patients admitted with complaints of CAUTI of age group ≥18 years, both male and female and those who give consent voluntarily to participate in the study. Pregnant and lactating women and patients whose cause of UTI is other than catheter induced were excluded from the study. Assuming 95% confidence interval and 10% absolute precision sample size was calculated by using the following Cochran's formula:

$n = (Z\alpha/2)\ 2 \times pq\ /d2$

Sample size(n) was found to be 81. Data collection tools include data collection proforma and Quality of life questionnaire.

BRIEF STUDY PROCEDURE

A prospective observational study on was conducted at the department of general medicine at Pushpagiri Medical College Hospital, Tiruvalla. The study was conducted after getting approval from the Institutional Ethics Committee. Patients with catheter associated UTI were identified. All patients were given a brief introduction about the procedure and confidentiality of the data. A written informed consent was obtained from the patient /bystander. A standard data collection form was prepared and patient demographic data, comorbidities, type of CAUTI, including duration of catheterization was collected from the individuals. Laboratory parameters such as blood reports, urine culture sensitivity data, cell count, ESBL production was recorded and documented. The details on pathogen, antibiotic treatment given, dose, duration of treatment, culture and antibiotic sensitivity was collected from patient file. Complications if present were documented. The quality of life of patients was assessed using questionnaire and education was provided for the prevention and management of CAUTI. The quality of life of patients was reassessed at the time of review.

STATISTICAL ANALYSIS

The information collected on the proforma were uploaded in an excel sheet and data was analysed using IBM SPSS. For obtaining the continuous variables, the results are either given in Mean ± SD and for categorical variables as percentage. To obtain the association between categorical variables, Chi Square Test and Fisher's Exact Test were applied. Wilcoxon Signed Rank test is used for pre and post score analysis. A P value of < 0.05 is considered as statistically significant.

RESULT AND DISCUSSION

The present study aimed to assess the risk factors and antibiotic sensitivity in catheter associated urinary tract infection.

1. RISK FACTORS ASSOCIATED WITH CAUTI.

A total of 81 patients were included in the study. There were 52(64.20%) males and 29 (35.80%) females. Majority of the patients were in the age group of 66-75 years. The mean age of the patients was 70 ±10.43 years. In patient specific risk factor, increasing age contribute greatly to the risk of CAUTI. From this study it was found that 77(24.52%) patients were above 50 years of age which contribute as a major risk factor for CAUTI. As individuals age, the body's natural defense

mechanisms gradually diminish, and the vital organs of the elderly begin to deteriorate, rendering them more vulnerable to acquiring CAUTI (Catheter-Associated Urinary Tract Infection). This was similar to the study conducted by Du Juanjuan *et al.* (2021) **[9]**. Prolonged duration of catheterization is another significant factor for the occurrence of CAUTI in the population. 73(23.25%) of the population has a duration of catheterization >14 days. The presence of a permanent urinary catheter disrupts the natural environment of the urethra and compromises the immune system's ability to phagocytize neutrophils effectively. This impairment affects the bladder's physiological function against bacteria, facilitating their entry into the bladder and ureter. Consequently, the proliferation of organisms within the urinary system can lead to infection. This was similar to the study conducted by Sunil Kumar D Chavan *et al*. (2020) **[6]**. Diabetes was another major risk factor 52(16.26%) followed by history of recurrent UTI 31(9.87%), menopause 29(9.24%), female 29(9.87%), presence of renal calculi 10(3.18%), immunocompromised conditions 7(2.23%) and use of antidiabetic drugs that is SGLT2 inhibitors 6(1.91%). **(Figure 1)**

2. BACTERIOLOGICAL PROFILE OF CAUTI

The most prevalent organism identified in our study was *Klebsiella pneumonia* 38(46.91%) followed by *E. coli* 24(29.63%). In the study conducted by Nandini M.S *et al*. (2016) **[10]**, *Klebsiella pneumonia* was identified as the second most prevalent pathogen**.** Among gram positive organism *Enterococcus faecalis* was found to be 6(7.41%) followed by *Staphylococcus species* 1(1.23%) **(Figure 2)**. As a result of the indiscriminate and widespread use of antibiotics, *Klebsiella pneumonia* produces high levels extended spectrum beta lactamase (ESBL), which can contribute to resistance of most antibiotics.

3. QUALITY OF LIFE IN PATIENTS AFTER CATHETERIZATION.

Statistically the results show significant improvement in the overall quality of life (p=0.000) and in the scores of all the domains, social relationship (p=0.000), physical capacity (p=0.000) and level of independence (p=0.000) after the implementation of the education programme **(Table 1)**.

4. ANTIBIOTIC SENSITIVITY PATTERN IN CAUTI

On analysis of the antibiotic sensitivity pattern in gram-negative organisms, *Klebsiella pneumoniae* showed high level of resistance to Ampicillin (94.74%) followed by Linezolid (84.21%) and was least resistant to Amikacin (23.68%) **(Figure 3.1)**. With *E coli*, highest

resistance rate was shown by Nalidixic acid (100%) followed by Linezolid and Levofloxacin (87.50%) and the least resistance rate was shown by Amikacin and Nitrofurantoin (25%) **(Figure 3.2)**. In case of *Pseudomonas aeruginosa*, the organism is highly resistant to Fosfomycin (42.86%) followed by Levofloxacin, Linezolid, Meropenem, Nalidixic acid, Nitrofurantoin (28.57%) and least resistant to Amikacin, Aztreonam (14.29%) **(Figure 3.3)**.

In gram-positive organism, *Enterococcus* was found to be high rate of resistance to Nitrofurantoin (83.33%) followed by Meropenem (66.67%) and was least resistant to Linezolid (0.00%) **(Figure 3 4)**. With *Staphylococcus* it was highly resistant to Ampicillin, Aztreonam, Nalidixic Acid (100%) and least resistant to Nitrofurantoin, Linezolid (0.00%) respectively **(Figure 3.5)**.

More than half of the isolated species displayed resistance to commonly used antibacterial medications. This resistance could stem from factors such as over- or under-dosing of antimicrobial drugs in the treatment of infectious diseases, as well as the widespread and indiscriminate use of antibiotics, which inevitably contributes to the emergence of resistance. Carbapenem, a highly effective antibiotic for combating infections caused by Gram-negative bacteria, has long been the primary treatment option for infections associated with ESBL-producing bacteria. Nevertheless, the escalating resistance to carbapenems is a cause for concern, posing a potential future global crisis **[11, 12]**.

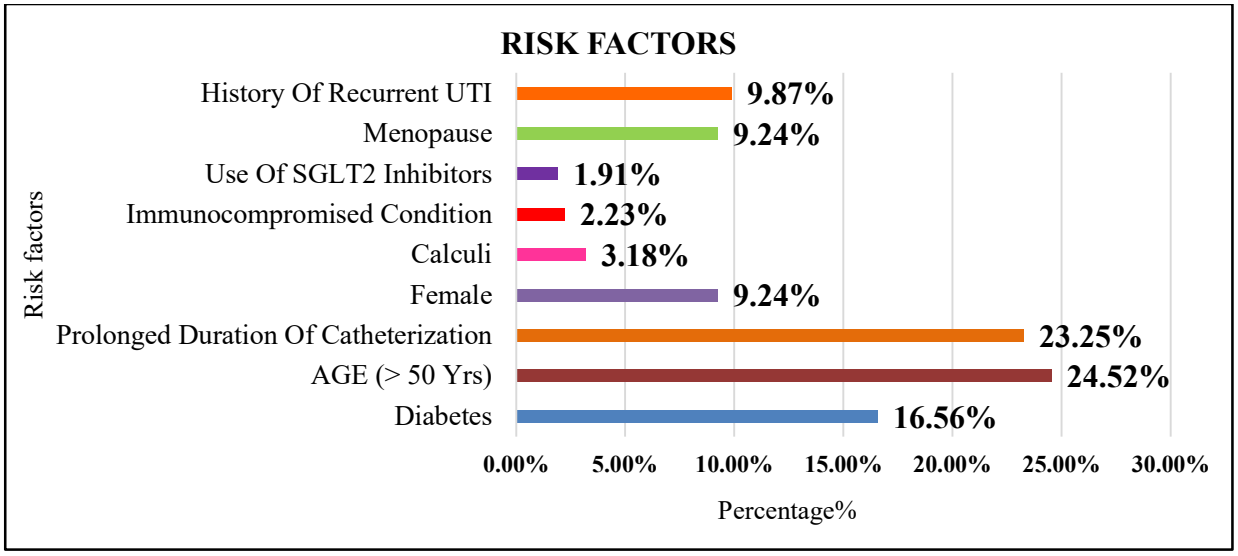

Figure 1: Risk factors of CAUTI

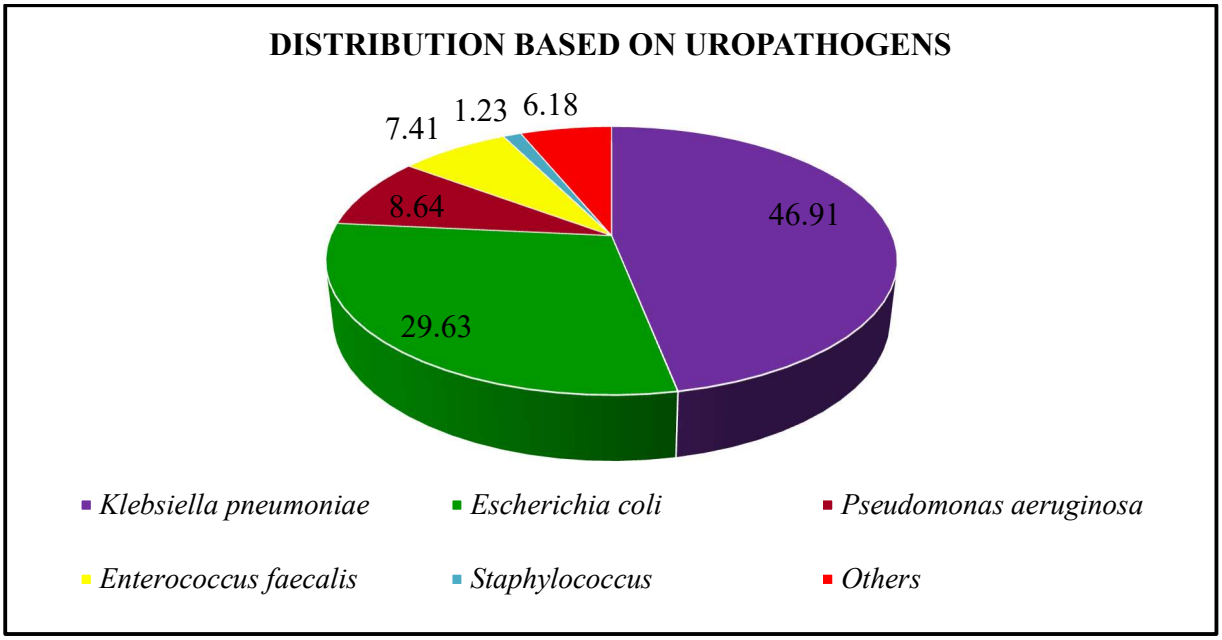

Figure 2: Distribution based on uropathogens
others- Burkholderia Cepacian, Citrobacter Koseri, Serratia Marcescens, streptococcus, fungi

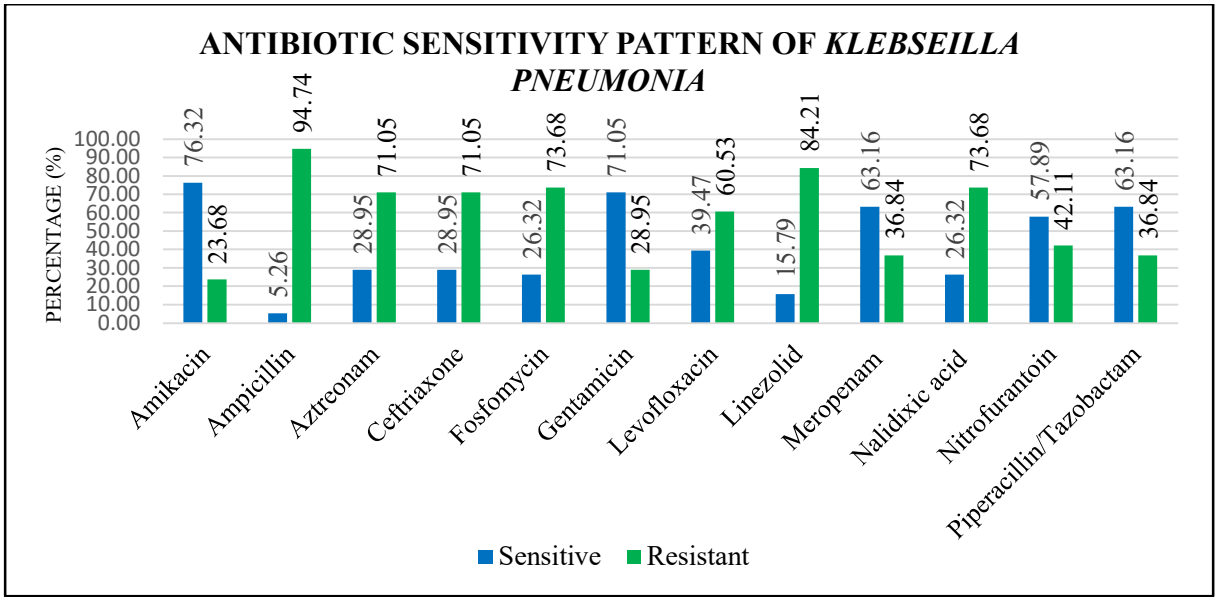

Figure 3.1: Antibiotic sensitivity pattern of *Klebsiella pneumonia*

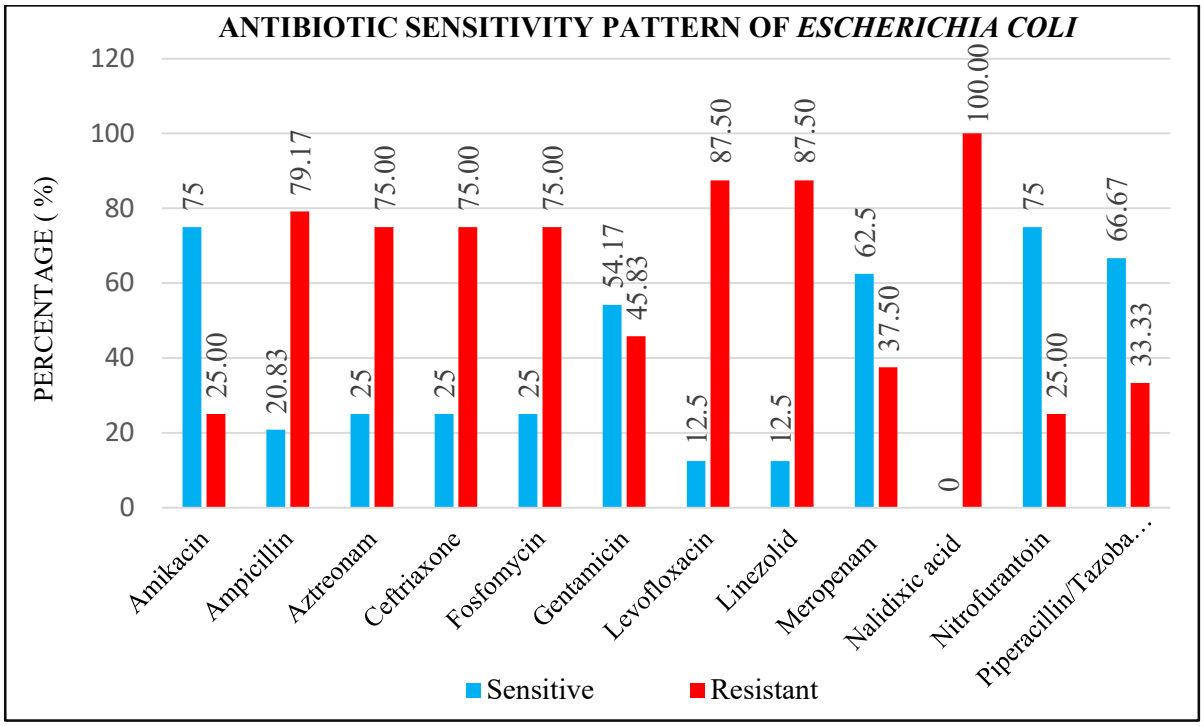

Figure 3.2: Antibiotic sensitivity pattern of *Escherichia coli*

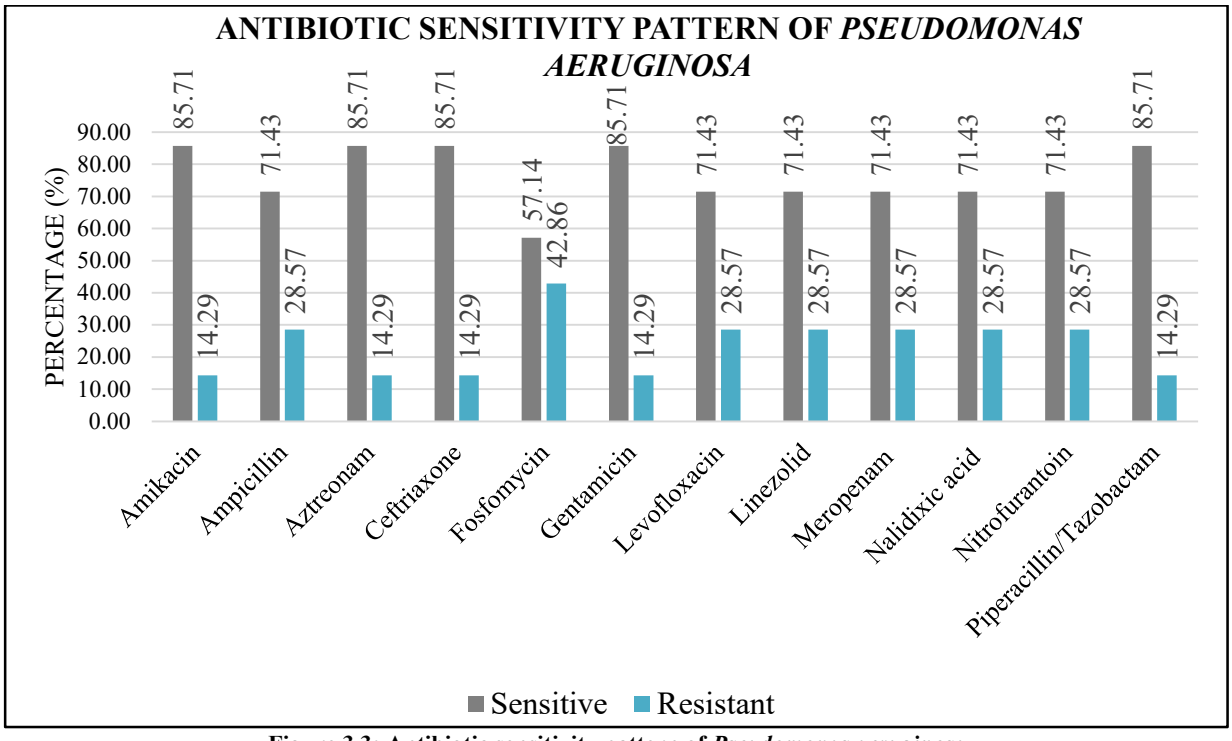

Figure 3.3: Antibiotic sensitivity pattern of *Pseudomonas aeruginosa*

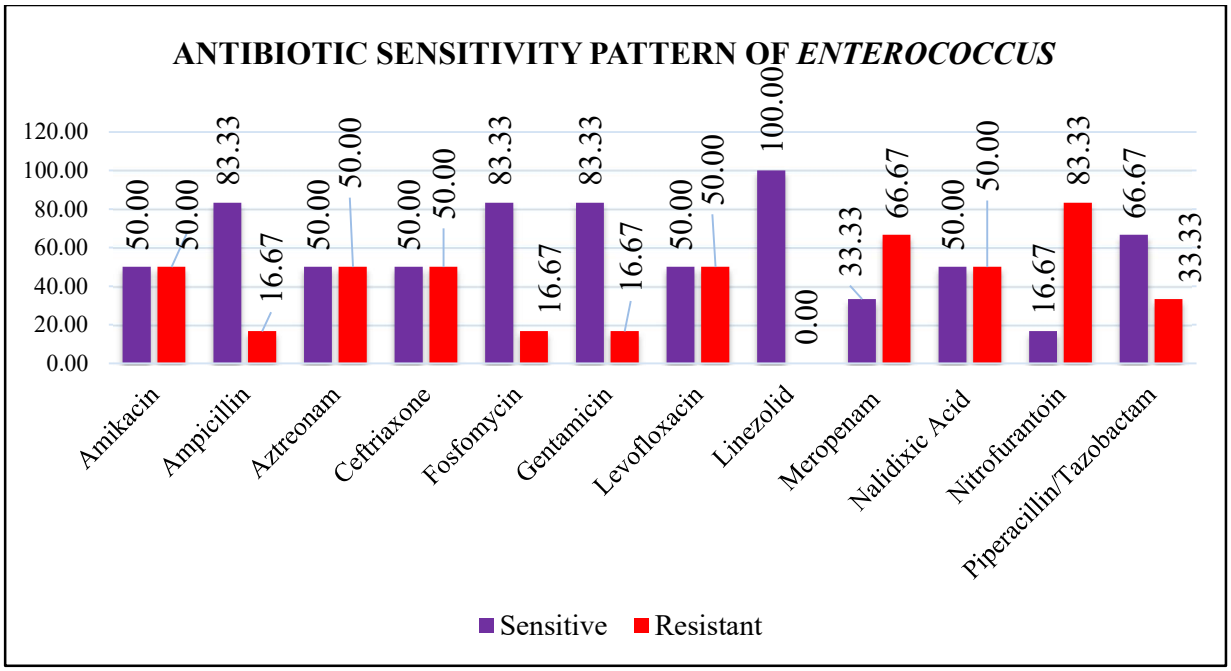

Figure 3.4: Antibiotic sensitivity pattern of *Enterococcus*

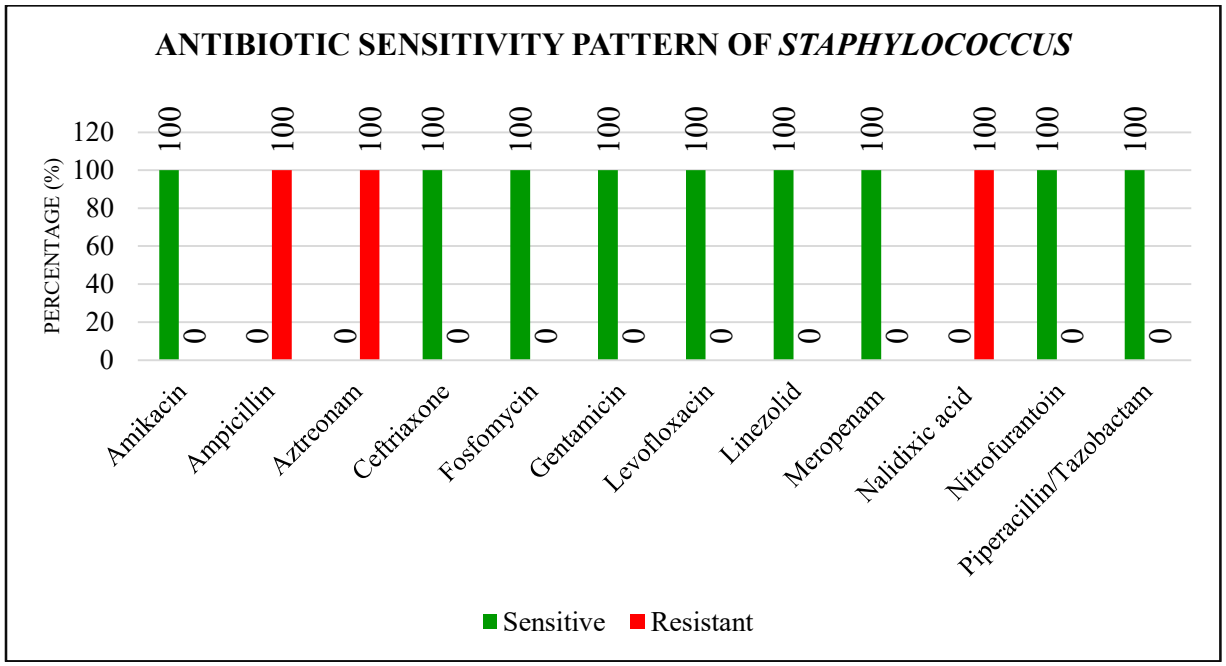

Figure 3.5: Antibiotic sensitivity pattern of *Staphylococcus*

Table 1: Quality of life of patients

	Mean	Standard deviation	Standard error mean	Z	P-Value
Over All Quality of Life	**-4.469**	**2.151**	**.239**	**-7.723**	**0.000**
DOMAINS OF QUALITY OF LIFE					
Social Relationship	**-.716**	**.762**	**.085**	**-6.117**	**0.000**
Physical Capacity	**-2.679**	**1.649**	**.183**	**-7.259**	**0.000**
Level Of Independence	**-.951**	**.947**	**.105**	**-6.180**	**0.000**

CONCLUSION

One of the biggest issues in healthcare is the incidence of catheter-associated urinary tract infections (CAUTIs) in hospitals. There are numerous risk factors that contributes to the development of CAUTI in hospitalised patients, which could lead to an increase in patient mortality. Increased age has found to be the most common risk factor in our study. It was discovered that the uropathogens isolated from CAUTI cases were multidrug resistant. In this study the major organism i.e., *Klebsiella pneumonia* shows high resistance to Ampicillin, linezolid and Nalidixic acid, which where the commonly used antibiotics. One of the major dangers facing today's global health and development is antibiotic resistance. The necessity of Antimicrobial Stewardship programmes to encourage proper use of antibiotics and reduce the possibility of later development of resistance is highlighted by the rising global prevalence of illnesses brought on by ESBL-producing organisms. These all can be resolved by proper use of antibiotics according to CDC guidelines or following antibiotic policy in the hospital. Pharmacists should participate in interdisciplinary work groups and committees within the health system that are important to Antimicrobial Stewardship, infection prevention and control, and clinical activities focused on appropriate antibiotic utilisation**.**

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Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/ publication of this article.

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Ethical Consideration

Institutional Research/ Human Ethics Committee approval was obtained with IEC no:

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- PCP/IEC-02B/17/PD-2022

- PCP/IEC-02B/18/PD-2022

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