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Original Research Article

A study on the pattern of antibiotic resistance on different infective organisms in a tertiary care hospital

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ABSTRACT

Background: A serious problem for global health, antibiotic resistance raises morbidity, mortality, and medical expenses. A clear understanding of local resistance patterns is required to maximize empirical therapy and infection control. Objectives of the study was to identify infective organisms and determine their antibiotic resistance profiles in a tertiary care hospital. To assess the resistance patterns across various antibiotic classes.
Methods: A cross-sectional study was conducted in a tertiary care center. Clinical specimens (pus, urine, sputum, blood, and tissue) were obtained and processed using standard microbiological culture techniques. Isolates were identified, and antibiotic susceptibility testing was performed via the disc diffusion method in accordance with Clinical and Laboratory Standards Institute (CLSI) guidelines.
Results: As a result, the present data analysis releaving that the culture positive was seen more in the 46-65 age range and with a higher propotion of females. The majority of the isolated organisms were *Escherichia coli* (23%), *Staphyloccus aureus* (21%), *Klebisella pneumonia* (21%), *Pseudomonas aeruginosa* (11%). The sample that grew organisms were pus (65), urine (13), sputum (17), blood (3), tissue (2).
Conclusions: The prevalence of drug-resistant infections, particularly in patients aged 46–65 and among females, underscores the importance of routine antimicrobial surveillance. E. coli's high cefuroxime resistance and maintained amikacin susceptibility highlight the need for evidence-based empirical therapy. Strengthening hospital-based antibiotic stewardship programs is recommended to curb the spread of resistance.

Keywords: Antibiotic resistance, *Escherichia coli*, Tertiary Care Hospital, Empirical therapy, Antimicrobial susceptibility

INTRODUCTION

Antibiotics are very effective in treating bacterial infections in humans. These antibiotics work by targeting and killing bacteria or inhibiting their growth. Overuse and misuse of antibiotics have led to the emergence of antibiotic resistance strains of bacteria.

Antibiotics have been the foundation of contemporary medicine. Antibiotic resistance is a global public health concern that poses a threat to humankind. The highest rate of infectious disease burden in the world is found in India, where improper and illogical use of antibiotics to treat illnesses has been linked to an increase in the development of antimicrobial resistance.[1]

AMR increases mortality, raises medical expenses, and lengthens hospital stays. At least one regularly used antibiotic is resistant to over 70% of bacterial species. The two main causes of the rise in antibiotic resistance are improper or insufficient empirical therapy and prolonged antibiotic use.[2]

In order to create a consistent international nomenclature for describing acquired resistance profiles in Staphylococcus aureus, Enterococcus spp., Enterobacteriaceae (apart from Shigella and Salmonella), Pseudomonas aeruginosa, and Acinetobacter spp., a group of experts from around the world came together through a joint initiative between the Centers for Disease Control and Prevention (CDC) and the European Centre for Disease Prevention and Control (ECDC). Multidrug resistance is a risk for these bacteria, which are often responsible for diseases associated with healthcare environments.[3]

Antibiotic stewardship programs involve not just avoiding the overuse of antibiotics but also choosing the appropriate antibiotic type, dosage, length of therapy, and delivery method. Antibiotic stewardship programs also attempt to prevent treatment costs, adverse medication reactions, and antibiotic resistance.[2]

The initial reports of vancomycin-resistant Staphylococcus aureus (VRSA) from the United States in 2002, Brazil in 2005, Jordan in 2006, and India in 2006 clearly demonstrate this. Vancomycin-resistant Enterococci were another case of resistance discovered in the late 1980s. In poor nations like India, where the morbidity and mortality rates from infectious diseases are still high, controlling infections would be a difficult task. When pencillinase-resistant penicillins were first introduced in 1990, Methicillin-resistant Staphylococcus aureus (MRSA) was discovered.[14]

A recent study found that bacterial resistance continues to pose a major threat to public health worldwide, accounting for 700,000 to several million deaths per year.[8] According to WHO estimates, antimicrobial resistance (AMR) may result in 350 million deaths by 2050. The public is therefore being urged to take worldwide collaborative action to counter the issue, which includes suggesting international antimicrobial resistance treaties. less developed healthcare systems in less developed nations.[4]

Drug degradation/alteration (e.g., ESBL, aminoglycoside-modifying enzymes, or chloramphenicol acetyltransferases); modification of drug binding sites/targets; and changes in cell permeability and efflux pump expression, which lead to decreased intracellular drug accumulation are some of the broad categories into which the mechanisms of drug resistance fall.[8]

There are numerous reports regarding the rise in antibiotic resistance from various nations, such as the US, Brazil, India, and Jordan. Vancomycin-resistant Enterococci and Vancomycin-resistant Staphylococcus aureus (VRSA) are included in these papers.[18]

In this study, we examine the pattern of antibiotic sensitivity and resistance using the outcomes of microbiological specimen cultures obtained from hospitalized patients. The information gathered might be essential for pathogen identification and the choice of empirical antibiotic treatment.

METHODS

Study design

A cross-sectional observational study was conducted in Banglore, India at the MVJ Medical College and Research Hospital to assess the antibiotic sensitivity and resistance patterns among hospitalized patients. The study included 100 patients admitted to the Departments of General Medicine and General Surgery.

Inclusion criteria

Patients diagnosed with bacterial infections, who has been tested with culture and sensitivity. Age above 18 years.

Exclusion criteria

Patients with Immunocompromised patients, and who has been not treated with antibiotics.

Study population

Patients were enrolled based on predefined inclusion and exclusion criteria. Only those whose microbiological culture reports tested positive for bacterial growth were included in the study.

Specimen collection

Clinical specimens were collected from patients based on clinical indications and included: pus, urine, sputum, blood, tissue samples.

These specimens were subjected to microbiological analysis, and only culture-positive results were considered for further evaluation.

Data collection tools

Data were obtained using two standardized forms

Patient data collection form - used to record patient demographic details, clinical presentation, and relevant medical history.

Culture and sensitivity report form - used to document the isolated pathogens and their antibiotic susceptibility profiles.

Outcome assessment

Patient outcomes were analyzed after culture results were obtained. The treatment response and appropriateness of empirical antibiotic therapy were evaluated based on the sensitivity patterns.

Data analysis

The collected data were systematically compiled and entered into Microsoft Excel (MX-Excel) for statistical analysis. The choice of descriptive statistical methods was based on the distribution of data, which was assessed using normal probability plots.

The mean and standard deviation were computed using data that was regularly distributed.

The median and interquartile range were applied to data that was not normally distributed.

Variables that are classified were summarized using frequencies and percentages.

RESULTS

Sociodemographic profile scale

During these study period, a sum of 100 culture positive cases was collected from general medicine, Surgery Department of MVJ Medical College and Research Hospital. The results after analysis of data are contained in this chapter. Based on collected data from the patient descriptive analysis was carried out and the results were found. From sociodemographic profile scale, age distribution, 6 were between 18-25 years, 20 were between 26-45 years, 41 were between 46-65 years and 33 were above 65 years as shown in Table 1. Gender distribution, 43 were male and 57 were female (Table 1).

Table 1: Age and gender distribution.

Variable	Mean	Median	SD	SD Max	SD MIN	Variance	Range	N	%
Age (years)	25	26.5	15.340	41	6	235.33	35	100	-
18-25	0	0	0	0	0	0	0	0	6
26-45	0	0	0	0	0	0	0	0	20
46-65	0	0	0	0	0	0	0	0	41
Above 65	0	0	0	0	0	0	0		33
Gender	50	50	9.899	57	43	98	14	100	-
Male	0	0	0	0	0	0	0	0	43
Female	0	0	0	0	0	0	0	0	57

Table 2: Frequency of organisms.

Organism	Frequency	Percentage
E. coli	25	25
Staphylococcus aureus	21	21
Klebisella pneumonia	21	21
Pseudomonas aeruginosa	11	11
Acinetobacter baumanii complex	13	13
Enterococcus faecium	04	04
Enterobacter cloacae	03	03
Coagulasenegative staphylococcus	02	02
Total	100	100

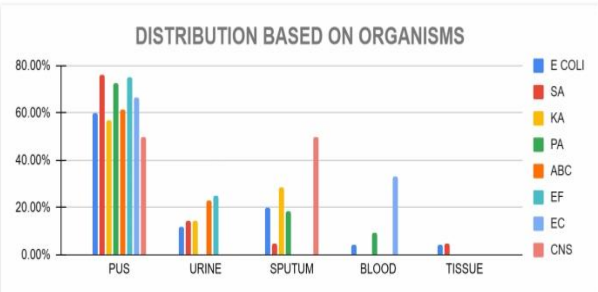

Figure 1: Type of culture sample.

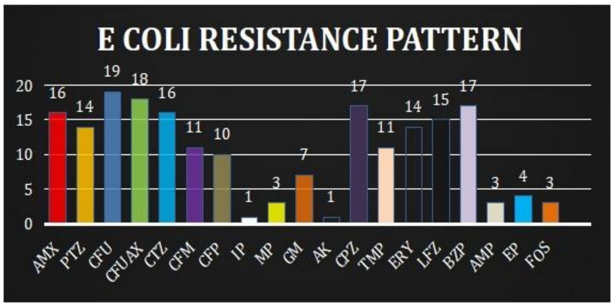

Figure 2: *E. coli* resistance pattern.

Type of culture sample and organism isolated

The following samples provide the positive isolated from: pus (n=65), urine (n=13), sputum (n=17), blood (n=3), tissue (n=2). The most common isolate from pus is Streptococcus aureus succeeded by E. coli, Klebsiella pneumonia. (Figure 1).

Frequency of organisms isolated

E. coli (25%) is the most commonly isolated organism, succeeded by *Staphylococcus aureus* (21%), *Klebisella pneumonia* (21%), *Acinetobacter baumanii* complex (13%), *Pseudomonas aeruginosa* (11%). The frequency of organism isolated are shown in (Table 2).

Antibiotic resistance pattern of isolates

E. coli

Based on the collected data, we found that *E. coli* was having resistance of Cefuroxime (76%), succeeded by Cefuroxime Axetil (72%), Ciprofloxacin (68%), Benzylpenicillin (68%) (Figure 2).

Staphylococcus aureus

Based on the collected data, we found that *Staphylococcus aureus* was having resistance to Benzylpenicillin (80.9%), succeeded by Levofloxacin (71.4%), Ertapenem (66.6%), Ciprofloxacin (52.3%) (Figure 3).

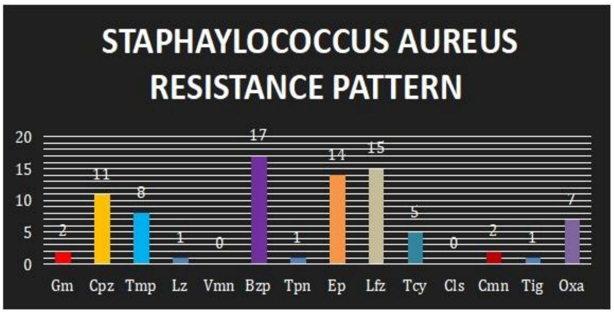

Figure 3: *Staphylococcus aureus* resistance pattern.

Table 3: Resistance pattern of other isolated organisms.

Antibiotics	*E coli*	*SA*	*KP*	*PA*	*ABC*	*EF*	*EC*	*CNS*
Amx	64	0	33.3	9	23	50	100	0
Ptz	52	0	28.5	9	38.4	50	33.3	0
Cfu	76	0	52.3	0	23	50	66.6	0
Cfu ax	72	0	57.1	0	23	50	66.6	0
Ctx	64	0	52.3	0	23	75	66.6	50
Cfp	40	0	14.2	0	23	25	0	0
Cfm	44	0	0	18.1	15.3	50	0	0
Ip	4	0	4.76	9	0	25	0	0
Mp	12	0	0	9	7.6	0	0	0
Ak	4	0	9.5	27.2	30.7	0	0	0
Gm	28	9.5	19	27.2	46.1	50	0	0
Cpx	68	52.3	52.3	45.4	53.8	50	66.6	50
Tmp	44	38	38	27.2	61.5	50	33.3	0
Lfx	60	4.7	0	18.1	46.1	0	0	0
Emn	56	0	0	0	0	0	0	100
Bzp	68	80.9	0	0	0	0	0	100
Oxa	0	33.3	0	0	0	0	0	50
Cmn	0	9.5	0	0	0	0	0	50
Lz	0	4.7	0	0	0	0	0	0
Col	0	0	0	0	0	0	0	0
Tig	0	4.76	0	0	7.6	0	0	0
Vmn	0	0	0	0	0	0	0	0
Tcy	0	23.8	0	0	0	0	0	0
Tpn	0	4.7	0	0	0	0	0	0
Amp	12	0	0	0	0	0	0	0
Ep	16	66.6	4.76	0	0	0	0	0
Cfd	0	0	14.2	18.1	23	0	0	0
Fos	12	0	4.76	0	0	0	0	0

Amx-Amoxicillin/Clavulanate; Ptz-PiperacillinTazobactem; Cfu-Cefuroxime; Cfuax-CefuroximeAxetil; Ctx-Ceftriaxone; Cfp-Cefaperazone; Cfm-Cefepime; Ip-Imepenem; Mp-Meropenem; Ak-Amikacin; Gm-Gentamicin; Cpx-Ciprofloxacin; Tmp-Trimethoprim/Sulfamethaxozale; Lfx-Levofloxacin; Emn-Erythromycin; Bzp-Benzylpenicillin; Oxa-Oxacillin; Cmn-Clinadamycin; Lz-Linezalid;Col-Colistin; Tig-Tigecucline; Vmn-Vancomycin; Tcy-Tetracycline; Tpn-Teicoplanin; Amp-Ampicillin; Ep-Ertapenem; Cfd-Cefatazidime; Fos-Fosfomicin; E.coli-Escherichiacoli; SA-Staphylococcusaureus; KA-Klebsiellapneumonia; PA-Pseudomonasauruginosa; ABC-Acinetobacter baumanii comlex; EF-Enterococcus faecium; EC-Enterobacter cloacae

Table 4: Sensitive Pattern of another sensitive pattern.

Antibiotics	*E coli*	*SA*	*KP*	*PA*	*ABC*	*EF*	*EC*	*CNS*
Amx	24	0	71.4	18.1	0	0	0	0
Ptz	48	0	61.9	72.7	30.7	0	100	0
Cfu	4	0	47.6	0	0	0	0	0
Cfu ax	12	0	33.3	0	15.3	0	0	0
Ctx	20	0	47.6	0	15.3	25	0	50
Cfp	36	0	76.1	81.8	38.4	0	100	0
Cfm	36	0	52.3	72.7	23	0	100	50
IP	52	0	61.9	72.7	76.9	75	100	0
Mp	64	0	95.2	63.6	76.9	0	100	0
Ak	80	0	90.4	63.6	38.4	75	100	0
Gm	52	57.1	76.1	18.1	46.1	50	100	100
Cpx	20	28.5	33.3	63.6	23	25	33.3	0
Tmp	48	61.9	52.3	9	23	0	66.6	100
Lfx	24	28.5	0	45.4	23	0	33.3	0
Emn	20	0	0	0	0	0	0	0
Bzp	12	14.2	0	9	0	0	0	0
Oxa	0	28.5	0	0	0	0	0	0
Cmn	0	57.1	0	0	30.7	0	0	50
Lz	0	76.1	0	0	0	0	0	100
Col	0	14.2	0	0	0	0	0	0
Tig	0	4.76	9.5	0	7.6	0	33.3	0
Vmn	0	85.7	0	0	0	0	0	100
Tcy	0	61.9	0	0	0	25	0	50
Tpn	0	47.6	0	0	0	25	0	50
Amp	32	0	0	0	0	25	0	0
Ep	40	23.8	14.2	18.1	0	0	33.3	0
Cfd	0	0	0	63.6	0	0	33.3	0
Fos	12	0	9.5	0	0	0	0	0

Antibiotic sensitivity pattern of isolates

E. coli sensitivity pattern

Based on the collected data, we found that *E. coli* has sensitivity to Amikacin (80%), Meropenem (64%), Imepenem (52%), Piperacillin- tazobactam (48%) (Figure 4).

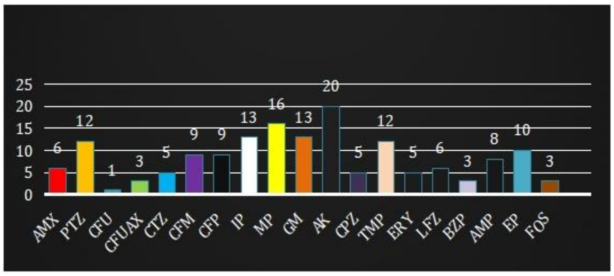

Figure 4: *E coli* sensitivity pattern.

Staphylococcus aureus sensitivity pattern

Based on the collected data, we found that *Stapylococcus aureus* has sensitivity to Vancomycin (85.7%), Linezolid (76.1%), Tetracyclin (61.9%), Trimethoprim/ Sulfamethoxazole (61.9%) (Figure 5).

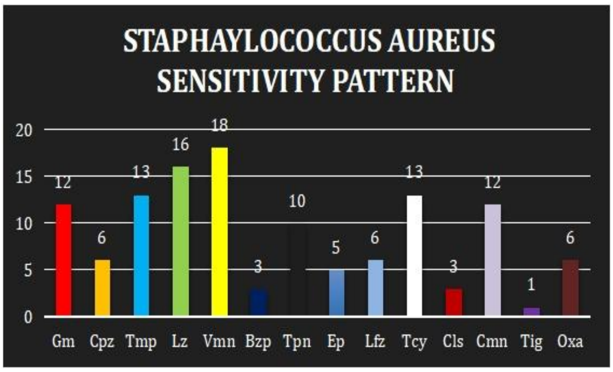

Figure 5: *Staphylococcus Aureus* sensitivity pattern.

DISCUSSION

Understanding microbial pathogens and their infections is crucial for controlling diseases and monitoring antibiotic resistance. Antibiotics have been essential in modern medicine, but antibiotic resistance occurs when bacteria can survive exposure to them. India faces challenges with antimicrobial resistance due to financial constraints, poor infrastructure, high disease burden, and unregulated antibiotic sales.[1,4,5] Antibiotic management programs are not only to prevent the unnecessary use of antibiotics, but also to select the type, dose, duration of treatment and the appropriate route of administration. Prevention of antibiotic resistance, adverse drug reactions, and treatment costs are other goals of antibiotic stewardship programs. A study is being conducted to determine the prevalence of common pathogens and their susceptibility to antibiotics.[29,30]

The clinical trial performed by Mohammad, Alireza et al, found that most commonly prescribed antibiotics were carbapenems providing internal guidelines for infection disease specialist, clinical pharmacist to avoid wide spread use of broad spectrum of antibiotics.[2] In systemic review and meta-analysis studies which was performed by Abbas, Zahra and Azad Khaledi et al concluded that gram negative pathogens such as E. coli were the most agents of UTI, ampicillin needs new strategy for treatment of UTI after kidney transplant.[19]

This study was conducted in Surgery, OBG and General Medicine Department. This observational study was carried out for period of 6 months at the inpatient Department in the Hospital. Our study was performed by using patient demographic data and antimicrobial susceptibility test report form. By using this different tool of data, we collected samples for each from each subject.

Tauseef and M. Hassan Shahid found that the resistance and sensitivity patterns change with time in their clinical investigations. With commonly used first-line antibiotics including ampicillin, clavulanic acid, and ceftriaxone, the highest level of resistance was found. Azithromycin, cefoxitin, and cefaclor were the least resistant gram-positive and gram-negative bacteria.

The results of this multistate prevalence assessment of infections linked to healthcare imply that public health surveillance and prevention efforts should continue to target C. difficile infections, according to Shelley, Jonathan R. Edwards' clinical study findings.

According to the results of a clinical trial by Depuydt, Pieter O, and Vandewoude, the tracheal monitoring culture in the intensive care unit predicted that 70% of patients would have a bloodstream infection linked to pneumonia that was caused by several drugs, while 15% of patients will have discordant-resistant microorganisms. While reducing antibiotic use, adding surveillance culture data moderately improved the appropriateness of early antibiotic therapy in the subgroup of patients with two risk factors for multiple-drug-resistant infections.

In this study we assessed that antibiotic resistance in different classes of antibiotics and identified the prevalence of different infectious organisms among patients. It included 100 cases that the culture was positive, with a higher prevalence in women than in men, especially in the age group of 46 to 65. The main results which say that Staphylococcus aureus was identified as the most prevalent organism detected in the Pus test, followed by *E. coli* and *Klebsiella pneumoniae*.

The document lists different antibiotics and their resistance profiles against specific organisms: *E. coli* shows highest resistance To Cefuroxime (76%) succeeded by Ciprofloxacin (68%), Benzylpenicillin (68% (Figure 2).

Antibiotic administration programs are essential to identify the type of organism, its susceptibility and resistance trends. It helps to reduce the use of antibiotics when necessary to prevent future antibiotic resistance. The importance of improving the use of antibiotics and better storage of supplies to ensure that medicines are available for future generations.

Our findings were consistent with those of a prior clinical experiment conducted by Savanur SS et al in the research "study of antibiotic sensitivity and resistance pattern of bacteria isolates in ICU set up of tertiary care hospital".[1]

As the study was done with small sample size, the inference of the has limited value and less statistical power. Data collected is only of those who were available and willing to participate at the time of study. Results from culture and sensitivity testing may not come back right away. The bacteria may need a day or more to grow in the culture before the sensitivity test is finished. Based on clinical signs, the patient might need to begin empirical antibiotic treatment. The sensitivity test solely evaluates how well certain antibiotics work against the detected bacteria. Antibiotic resistance to drugs not tested for may exist, and the test may not cover all potential medicines. Inaccurate results may arise from contamination that occurs during sample collection, processing, or testing. Ensuring appropriate collection strategies is crucial in order to prevent false-positive outcomes.

CONCLUSION

To assess the antibiotic resistance in different class of antibiotic and to Identifying the prevalence of various infective organisms among patients, our study was conducted. among 100 cases that tested positive for culture, where women predominated over men. The 46–65 age group was more prevalent than the other age group. According to the data gathered from the culture-positive test, it was determined that the pus sample was more prevalent because *Staphyococcus aureus* was the organism with the greatest amount detected in the test, succeeded by *E. coli* and *Klebsiella pneumoniae*. Therefore, in order to start empirical antibiotics in emergency situations, antibiotic stewardship programs must be carried out to better identify the type of organism, their sensitivity, and their resistance trend. De-escalation of antibiotics, when necessary, must also be prioritized in order to stop future antibiotic overuse and boost antibiotic resistance in these species. Improved use of available medications results in better storage of supplies for upcoming generations.

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