

**A Retrospective Analysis of Antibigram on Urinary Isolates in a Tertiary Care Hospital, Dhanbad**Neetu Srivastava<sup>1</sup>, Abhinav Gaurav<sup>2</sup><sup>1</sup>Tutor, Department of Microbiology, Shaheed Nirmal Mahto Medical College and Hospital, Dhanbad, Jharkhand, India<sup>2</sup>MD Paediatrics, Consultant at Mayalok Children Hospital, Dhanbad, Jharkhand, India

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**Abstract**

**Background:** Urinary tract infections (UTIs) constitute one of the widespread bacterial infections globally and one of the primary causes of Morbidity especially in females and hospitalized patients. Empirical treatment has been difficult due to the growing development of antimicrobial resistance (AMR) of uropathogens. The importance of antibiogram studies in the local antibiotic susceptibility pattern and appropriate antibiotic therapy has been depicted.

**Methods:** The study was a retrospective observational study with the period of one year (January 2023 to December 2023) in a tertiary care hospital. The study comprised 100 culture-positive urine samples. The records on microbiology laboratories were used to obtain data. Microbiological processing of urine samples was done with standard procedures and identification done using conventional methods of isolates. The Kirby-Bauer disk diffusion technique was the method of antibiotic susceptibility testing and the results were interpreted based on the guidance of Clinical and Laboratory Standards Institute (CLSI).

**Results:** Escherichia coli predominated (E. coli) (60 %) followed by Klebsiella species (20 %), Proteus species (10 %) and Pseudomonas aeruginosa (7 %) as the predominant organisms of 100 isolates. Resistance was found to be high with respect to the commonly used antibiotics like ampicillin and cephalosporins and higher sensitivity was observed on nitrofurantoin, amikacin and imipenem. It was found that a proportion of the isolates were multidrug resistant.

**Conclusion:** The study identifies the increased issue of antimicrobial resistance of urinary pathogens. Periodic surveillance of antibiogram trends and enforcement of reasonable antibiotic guidelines are critical to inform the effective empirical treatment and patient treatment.

**Keywords:** Antibiogram, Antimicrobial Resistance, Urinary Tract Infection, Urinary Isolates.

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**Introduction**

Urinary tract infections (UTIs) are one of the most widespread Bacterial infection encountered in clinical occurrences that affect people of different ages and impose a considerable burden on morbidity and healthcare globally [1]. Depending on host factors and underlying conditions, UTIs may require different regions of the urinary system as the urethra, bladder, ureters, and kidneys and may be either uncomplicated or complicated infections [2].

They especially occur in women because of anatomical predisposition, but older people, hospitalized patients, and those with comorbidities, e.g., diabetes or catheterization, are also at risk. UTIs present clinically with mild cystitis, moderate pyelonephritis, and severe urosepsis, which require

timely diagnosis and timely antimicrobial therapy [3,4]. UTIs are among the most common causes of antibiotic prescriptions worldwide and millions of healthcare visits are attributed to it on a yearly basis [5]. The prevalence of the UTIs has been reported to be high in both the community setting and hospital setting across the various regions of the country with the prevalence rising in tertiary care centers where cases of complicated cases are more commonly treated [6,7]. This effect on the economy and clinical factors is further enhanced by the long-term hospitalization, frequent infections, and the development of resistant pathogens.

Gram-negative bacteria are the pathogenic agents of the etiological spectrum of UTIs, although E. coli is the most widely found causative agent, as it

causes the overwhelming majority of community-acquired and hospital-acquired infections [8,9]. Other common isolated pathogens will consist of *Klebsiella* species, *Proteus* species, *Pseudomonas aeruginosa*, Gram-positive organisms like *Enterococcus* species and *Staphylococcus saprophyticus* [10,11]. These pathogens and their distributions pattern in terms of antimicrobial susceptibility may differ according to geographic location, population of patients, and the healthcare setting.

One of the significant issues in the treatment of UTIs is the increasing problem of AMR that turned out to become a worldwide health issue [12]. Indiscriminate and irrational use of antibiotics has brought the emergence of multidrug-resistant (MDR) organisms that have rendered popular antibiotics like fluoroquinolones, cephalosporins, and penicillins ineffective [13]. This trend makes treatment strategies more difficult, high costs of healthcare, and is linked to worse clinical outcomes. Here empirical therapy, which is usually started before the results of the culture are known, will not work, unless it is based on local patterns of resistance.

A major role in dealing with this challenge has been played by the use of the antibiogram studies, which give cumulative data on the patterns of susceptibility of the local bacterial isolates. These examinations assist clinicians to choose the proper empirical antibiotics, in addition to assisting in tracking the trends of resistance over time, and institutional antibiotic policies and stewardship programs. Although their importance, the number of region-specific data is limited, especially in smaller cities, including Dhanbad, where prescribing habits and resistance pattern among the local population might not be similar to documented in metropolitan areas.

Thus, the current research will examine the bacterial profile and antibiotic susceptibility patterns of urinary sample in a tertiary care hospital in Dhanbad to produce a local antibiogram, which can be used to develop effective empirical therapy and make a contribution to the antimicrobial stewardship initiative.

### Objectives

- To determine the bacterial profile of urine isolates.
- To examine the pattern of antibiotic susceptibility.
- To guide empirical antibiotic treatment.

### Materials and Methods

**Study Design:** The study was done as a retrospective observational study, which was aimed at assessing the patterns of antibiograms of the

urinary isolates. The retrospective design was based on the examination of the past laboratory and clinical records, which did not include any direct contact with the patients so that the current patterns of antimicrobial susceptibility could be examined efficiently.

**Study Setting:** The research was conducted in the tertiary care hospital in Dhanbad, Jharkhand. It is a large referral hospital to populations around the city and the rural regions, having all-inclusive diagnostic and curative services, with a well-equipped microbiology laboratory.

**Study Duration:** The analysis involved the data obtained within one year, from January 2023-December 2023. This time was chosen because it was perceived that it would be enough to represent the samples and to monitor seasonal changes in the patterns of infections.

**Sample Size:** The study involved 100 culture-positive urine samples that had a positive culture based on bacterial growth. It is because these samples were chosen using predetermined inclusion and exclusion criteria so that the data would be dependable and consistent.

**Inclusion Criteria:** The research involved patients of any age and both genders that were suspected clinically of having urinary tract infections and were confirmed by positive reports of urine culture. Only the samples that showed a significant bacterial growth were to be analyzed.

**Exclusion Criteria:** Contaminated samples, mixed growth of more than one organism indicative of poor collection or incomplete laboratory or patient data were excluded to ensure the accuracy and validity of data within the study.

**Data Collection:** The microbiology laboratory records and hospital database were taken as the sources of data. The appropriate data, such as demographics of the patients, e.g., age and gender, and the data on isolated organisms and patterns of their sensitivity to antibiotics were documented and classified according to the analysis.

**Laboratory Methods:** The urine samples were handled in the conventional microbiological tests. According to the media, uropathogens were allowed to grow and differentiate on the suitable media like Cysteine Lactose Electrolyte Deficient (CLED) agar and MacConkey agar. Bacterial isolates were identified by morphology, Gram staining and conventional biochemical analysis. The Kirby-Bauer disk diffusion technique was performed on Mueller-Hinton agar to determine the susceptibility of the bacteria to antibiotics.

This was done as per the CLSI guidelines on the interpretation of sensitivity and resistance patterns.

**Statistical Analysis:** Descriptive statistical analysis was done on the collected data. The results were in frequency and percentages form to make them understandable. The statistical analysis was done in Microsoft Excel and in few cases in SPSS software to maintain the accuracy and to interpret the data properly.

## Results

**Demographic Distribution:** In this study 100 culture-positive urine samples were examined. The age distribution indicated that most of the cases

were observed in the 21-40 years old age category, then it keeps increasing to 41-60 years age showing that the sexually active and middle-aged population were more susceptible to the disease. Elderly patients (>60 years) who form a considerable proportion, apparently because of comorbidities and depressed immunity. Gender distribution was a higher proportion of cases was of female over male, which is congruent with the anatomical and physiological factors known to cause higher prevalence of urinary tract infection among women than males.

**Table 1: Demographic Distribution of Study Population**

Variable	Category	Number of Cases	Percentage (%)
Age Group	<20 years	10	10%
	21-40 years	40	40%
	41-60 years	30	30%
	>60 years	20	20%
Gender	Male	35	35%
	Female	65	65%

**Bacterial Isolates:** Urinary isolates were analyzed and it was shown that *E. coli* was the most common pathogen and it caused most of the infections. This was accompanied by *Klebsiella* species, *Proteus* species and *Pseudomonas aeruginosa*. Gram-

negative organisms outnumber Gram-positive ones highlights their high importance in the urinary tract infections among the community and the hospital. A lower percentage of the cases consisted of other less common pathogens.

**Table 2: Distribution of Bacterial Isolates**

Organism	Number of Isolates	Percentage (%)
<i>E. coli</i>	60	60%
<i>Klebsiella</i> spp.	20	20%
<i>Proteus</i> spp.	10	10%
<i>Pseudomonas aeruginosa</i>	7	7%
Others	3	3%

**Antibiogram Pattern:** The pattern of antibiotic susceptibility of the isolates showed different levels of resistance and sensitivity to the widely used antibiotics. Antibiotics like ampicillin, amoxicillin-clavulanic acid and some cephalosporins showed high resistance levels, which presupposes less effectiveness in using these medicines in empirical therapy. Fluoroquinolones including ciprofloxacin were identified to have moderate resistance.

Conversely, antibiotic such as nitrofurantoin, aminoglycosides (amikacin, gentamicin) and carbapenems were found to be more sensitive, implying that they could still be utilized in the treatment of UTIs.

The antibiogram points at the importance of paying attention to local resistance patterns when choosing the antibiotics.

**Table 3: Antibiotic Sensitivity Pattern of Urinary Isolates**

Antibiotic	Sensitivity (%)	Resistance (%)
Ampicillin	20%	80%
Amoxicillin-Clavulanic Acid	30%	70%
Ciprofloxacin	45%	55%
Ceftriaxone	40%	60%
Nitrofurantoin	75%	25%
Gentamicin	70%	30%
Amikacin	80%	20%
Imipenem	90%	10%

**Key Findings:** The results of the study show that the prevalence rate of antibiotic resistance among urinary isolates is very high, especially in relation to first-line antibiotic drugs, including ampicillin and cephalosporins. There was also a concerning trend of escalation of resistance to fluoroquinolones. Conversely, nitrofurantoin and amikacin showed relatively high efficacy and can be used as the options of empirical treatment in this case. Moreover, a subgroup of isolates demonstrated MDR, which implies the resistance to three or more antibiotic classes, which serves as a reminder that the issue of antimicrobial resistance becomes increasingly difficult. The results emphasize the role of constant surveillance and the creation of hospital-specific antibiograms to help in making rational decisions on the use of antibiotics.

### Discussion

The current retrospective study offers useful information about the bacterial profile at urinary isolates and the pattern of antibiotic susceptibility in a tertiary care hospital in Dhanbad. The results indicate that the *E. coli* species is the most common uropathogen identified and it predominately causes most of the cases then comes the *Klebsiella*, *Proteus*, and *Pseudomonas* species. This trend is in line with various studies that were carried in India and other parts of the world whereby *E. coli* was found to be the primary cause of urinary tract infections. *E. coli* pre-eminence can be explained by its occurrence as a normal commensal in the gastrointestinal tract, in addition to its virulence factors like adhesins, fimbriae, and biofilm forming capacity, enabling it to colonize and infect urinary tract.

The demographic distribution that is presented in this study as females and higher rates of the 21-40 years age group are more prevalent is consistent with the literature. The anatomical characteristics of the female body are the primary cause of the predisposition, as the urethra is shorter, and it is located near the anal part, which helps the bacteria to enter it. Moreover, hormonal and behavioral reasons can also be regarded to be more susceptible in this group.

The major observation in this study is that the level of resistance has been found to be high against widely used antibiotics like ampicillin, amoxicillin-clavulanic acid, and cephalosporins. The trends of resistance have been reported as similar in different studies carried in India, indicating the extensive and nonselective use of these antibiotics, both in the community and in hospitals. The world has been aware that the resistance towards first-line antibiotics is on the rise, and this is one of the biggest problems related to UTI treatment. The resistance to fluoroquinolones, including ciprofloxacin is also important, and traditionally

were used as empirical treatment of the UTIs. Over-the-counter pharmaceutical access to antibiotics, non-compliance with prescription regimens, self-prescription, and poor infection control techniques can be described as the factors that explain the increasing trends of AMR. In tertiary care units, there are complex cases and previous exposure to the antibiotics, which adds to the development of MDR organisms. The presence of MDR isolates in this study demonstrates the urgency of the effective antibiotic stewardship programs.

Conversely, antibiotics like nitrofurantoin, aminoglycosides (amikacin and gentamicin), and carbapenems (imipenem) had a greater sensitivity. These results are in parallel with [14], which have found maintained efficacy of these drugs towards uropathogens. Nitrofurantoin, specifically, is a consistent choice in the case of simple UTI since the drug is specific to the urinary activity and the rates of resistance are low [15]. Carbapenems are the important therapy that must be used as a last option in case of severe or complicated infections to prevent the development of resistance.

Clinically, the analysis of the study highlights the significance of the use of local antibiogram data to inform empirical treatment. The resistance patterns vary across the regions thus necessitating the creation of region-specific guidelines. The study offers essential evidence in the prescribing practice, particularly in Dhanbad where the data are region-specific and there is a limited amount of such data.

On the whole, the results indicate the necessity of ongoing monitoring, reasonable use of antibiotic drugs, and antimicrobial stewardship measures, which have to be implemented to contain the increasing problem of resistance and enhance patient outcomes.

### Limitations

The sample size was quite small (n=100), and it can be a drawback of the generalizability of the findings. As a retrospective study, it utilized available records, which might either be incomplete or missing. Also, the research was done in one tertiary care site and the findings might not be applicable in other health facilities. The insufficient clinical correspondence, including patient comorbidities and treatment outcomes, also limits the depth of analysis.

### Conclusion

This study has highlighted that the most prevalent uropathogen is *E. coli* and a large percentage of these isolates are resistant to the widely used antibiotics, including ampicillin and cephalosporins. It was more sensitive to nitrofurantoin, aminoglycosides and carbapenems.

The results emphasize the increasing issue of antimicrobial resistance and the need to update antibiograms on a regular basis. The key to the optimization of treatment results and prevention of the additional evolution of resistance is consistent with rational antibiotic prescriptions and the introduction of hospital-specific antibiotic policies.

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