Bacteriological Profile and Antibiotic Sensitivity Patterns: Formulating Effective Treatment Strategies in Clinical Isolates

Section B-Research paper

BACTERIOLOGICAL PROFILE AND ANTIBIOTIC SENSITIVITY PATTERNS: FORMULATING EFFECTIVE TREATMENT STRATEGIES IN CLINICAL ISOLATES

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Abstract

Background: Bacterial infections are a significant public health concern, and understanding the bacteriological profile and antibiotic sensitivity patterns of clinical isolates is crucial for effective treatment. This study aimed to investigate the bacteriological profile and antibiotic sensitivity patterns of clinical isolates obtained from patient samples attending a tertiary care hospital in Eastern Uttar Pradesh, India.

Materials and Methods: Throughout a certain time, 695 positiveclinical isolates were obtained from hospital outpatients as part of a cross-sectional investigation. Conventional bacteriological identification methods such as colony morphology, gram staining, and biochemical assays were used to determine the isolates' identities. As the Clinical and Laboratory Standards Institute (CLSI) recommended, the disc diffusion technique was used to determine antibiotic susceptibility. Following national and international standards, the tested antibiotics represented a broad spectrum of routinely used antibiotics across several classes.

Results: The analysis of the bacteriological profile revealed the presence of various bacterial pathogens among the clinical isolates. The most frequently isolated bacteria were 63.0% gram-negative fermenter (GNFB) followed by non-fermenter gram-negative bacteria (FNGNB) 19.0% and Gram Positive cocci 18.0%. Regarding antibiotic sensitivity patterns, the study found variations in the susceptibility profiles of different bacterial species to the tested different classes of antibiotics.

Conclusion: This study reveals clinical isolates' bacteriological profile and antibiotic sensitivity patterns. Antibiotic resistance patterns should be monitored regularly to enhance antibiotic selection and patient outcomes. Data can help create local antimicrobial stewardship programs and evidence-based treatment guidelines.

Keywords: Antimicrobial Stewardship, Antibiotic Sensitivity Patterns, Bacteriological Profile, Clinical Isolates,

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1. INTRODUCTION

Bacterial infections burden global healthcare systems significantly, leading to substantial morbidity, mortality, and economic losses. The emergence and spread of antibiotic-resistant bacteria have further complicated the management of infectious diseases. To effectively combat bacterial infections, it is crucial to understand the bacteriological profile and antibiotic sensitivity patterns of clinical isolates.[1]

Tertiary care hospitals are important settings for diagnosing and treating various infectious diseases. These centers handle a large volume of patients, including both acute and chronic infections. The knowledge of the prevalent bacterial pathogens and their susceptibility to antibiotics is essential for optimizing treatment strategies and preventing the inappropriate use of antibiotics.[2]

Eastern Uttar Pradesh (UP) in India, with its high population density and diverse demographics, faces numerous healthcare challenges, including the burden of infectious diseases. The region encompasses urban and rural areas, each with unique socioeconomic and environmental factors that influence the epidemiology of bacterial infections. Understanding the bacteriological profile and antibiotic sensitivity patterns specific to this region is crucial for tailoring treatment regimens and implementing effective infection control measures.[2]

Assessing the bacteriological profile involves identifying the spectrum of bacterial pathogens isolated from clinical samples. This information helps us understand the prevalence and distribution of different bacterial species responsible for infections. Furthermore, determining the antibiotic sensitivity patterns of these isolates provides insights into the efficacy of various antibiotics and guides physicians in selecting appropriate treatment options.[3]

Antibiotic resistance is a growing global concern, with bacterial pathogens acquiring resistance mechanisms through genetic mutations and horizontal gene transfer.[4] The inappropriate and indiscriminate use of antibiotics has contributed to the rapid emergence and spread of antibiotic-resistant bacteria. In resource-limited settings like Eastern UP, where access to healthcare and diagnostics may be challenging, the problem of antibiotic resistance becomes even more critical. Therefore, monitoring the antibiotic sensitivity patterns of clinical isolates from a tertiary hospital in Eastern UP is vital for optimizing empirical antibiotic therapy, preventing treatment failures, and reducing the selection pressure for antibiotic resistance.In the past five decades, the development and introduction of new antibacterial drugs into clinical practice have been limited, with only two new classes of drugs being discovered.[4] The high cost of production and the time-consuming process between regulatory approval and deployment have further hindered the availability of promising drugs or vaccines.[5, 6] As a result, the emergence and spread of bacterial resistance have become a growing concern in both developed and developing countries. Numerous studies have documented the escalating patterns of bacterial resistance, highlighting the urgent need for effective interventions.[6]

For instance, a study conducted in Western Nigeria examined uropathogens and found that 35.8% of urine samples demonstrated bacterial growth resistant to commonly used antibiotics.[7] Another study by Nmema et al. focused on Pseudomonas aeruginosa isolated from clinical samples collected in a tertiary hospital in Lagos, Nigeria.[8] The study revealed that 50% of the isolates were multidrug-resistant, and 40% exhibited resistance to imipenem and Meropenem, considered last-line antibiotics for gram-negative infections.[8] These findings underscore the increasing prevalence of resistant bacterial pathogens and the urgent need to periodically review infection patterns and antibiogram profiles of community-acquired bacterial infections.[9,10]

Such periodic reviews are crucial in developing local treatment guidelines and hospital antibiotic policies to optimize antibiotic use.[11] It becomes particularly important in settings where medical microbiology laboratory diagnostic capacity is limited, leading to a reliance on empirical treatment approaches.[12] Healthcare providers can make informed decisions regarding empirical treatment and implement appropriate infection control measures by understanding the local bacteriological profile and antibiotic resistance patterns.

Efforts to combat antibiotic resistance require a multifaceted approach, including antimicrobial stewardship programs, infection prevention and control measures, and research and development of novel antibacterial agents. These strategies aim to preserve the effectiveness of existing antibiotics, improve diagnostics, promote rational antibiotic use, and foster the discovery of new drugs. Additionally, international collaborations and policy frameworks are essential for addressing the global challenges of antibiotic resistance and ensuring access to effective treatments.[13]

Additionally, knowledge of the bacteriological profile and antibiotic sensitivity patterns can contribute to formulating local antimicrobial policy. These studies aim to promote the judicious use of antibiotics, prevent the emergence of antibiotic resistance, and improve patient outcomes. Understanding the bacteriological

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profile and antibiotic sensitivity patterns of clinical isolates from a tertiary hospital in Eastern UP is essential for effectively managing bacterial infections. It provides valuable insights into the prevalence, distribution, and antibiotic susceptibility of bacterial pathogens in the region. This information enables healthcare professionals to make informed decisions regarding empirical antibiotic therapy, optimize treatment regimens, and implement infection control measures. Furthermore, it contributes to developing local antimicrobial stewardship programs, promoting the rational use of antibiotics, and combating the rising threat of antibiotic resistance. By continuously monitoring and analyzing the bacteriological profile and antibiotic sensitivity patterns, healthcare systems can adapt strategies to the changing dynamics of bacterial infections and ensure better patient outcomes.

2. MATERIALS AND METHODS

Study Design: A cross-sectional study investigated the bacteriological profile and antibiotic sensitivity patterns in clinical isolates from a tertiary hospital in Eastern Uttar Pradesh (UP), India.

Study Site: The study was conducted at the Department of Microbiology, United Medicity Medical College & Hospital,Prayagraj, a prominent healthcare facility in Eastern UP.

Study Participants: The study included patients who visited the tertiary hospital's outpatient departments (OPD) and in-patient departments (IPD) during the study period and collected thesamples forbacterial culture and antibiotic susceptibility testing's. The participants comprised individuals of various age groups and genders seeking medical care for suspected bacterial infections.The clinical isolates were collected from the clinical bacteriology lab, United Medicity Medical College & Hospital, and appropriate consent was obtained from the patient participating in this study after explaining the sampling procedure and our work's aim.

Study Duration: The study was conducted over 1.6years, from June 2021 to December 2022. This duration was sufficient to collect a representative sample of clinical isolates from the patients.

Inclusion and Exclusion Criteria: The inclusion criteria for this study were individuals of all age groups who presented with clinical symptoms suggestive of bacterial infection and consented to participate. Patients on antibiotic therapy at the time of sample collection or with a history of

antibiotic use within the previous were excluded from the study.

Materials Used: The required material, like bacteriological culture media, biochemicals, antibiotic discs, and consumables, were procured from Hi-Media Pvt. Ltd. Mumbai.

Culture &Identification of bacterial isolates: the samples were streaked onto suitable culture media and incubated under optimal conditions for bacterial growth. Isolated colonies were subjected to standard microbiological techniques, including Gram staining, biochemical tests, and other relevant identification methods, to determine the bacterial species.

Antibiotic susceptibility testing: The Kirby-Bauer disk diffusion method, following the guidelines of the Clinical and Laboratory Standards Institute (CLSI), was employed to determine the susceptibility of the isolated bacteria to various antibiotics. The inhibition zones around each antibiotic disk were measured and interpreted according to established breakpoints.

Data collection and analysis: The results of bacterial Identification and antibiotic susceptibility testing were recorded systematically, ensuring accuracy and proper documentation.The collected data were analyzed using appropriate statistical methods. Descriptive statistics, such as frequencies and percentages, were calculated to summarize the clinical isolates' bacteriological profile and antibiotic sensitivity patterns.

3. RESULTS

A total of 695 positive culture of patients were included in the study, and the gender breakdown of those participants was analyzed. According to the findings **(Fig. 1)**, Male patients comprised 431 (62.02%) of the total. On the other side, there were a total of 264 females, which meant that they comprised 37.98% of the total population.

According to these data, a greater proportion of men are in the population under investigation than females. The gender disparity found in the sample gives rise to the hypothesis that there may be distinct differences between how males and females are represented in the particular setting that is the research focus. It is extremely important to have a good understanding of gender distribution since this knowledge may shed light on potential gender-related disparities in various elements, including health outcomes, behaviours, and social issues.
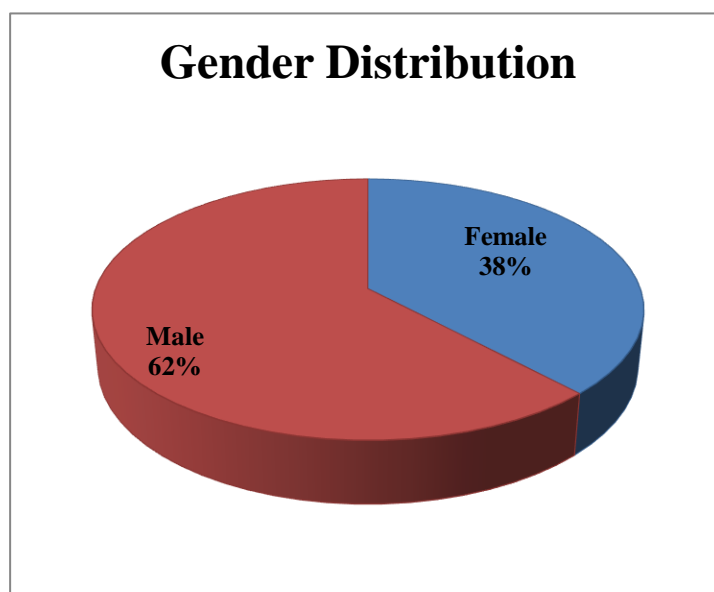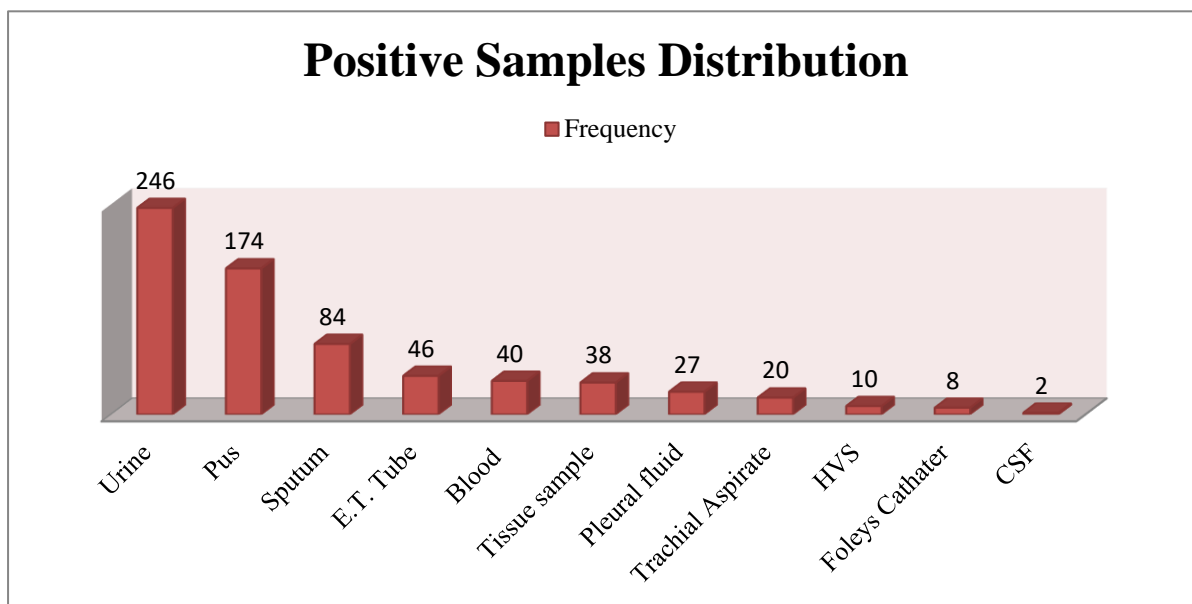
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Figure 1: Showed Gender Distribution

Table 1 depicted the sample distribution in the study, which included several types of specimens collected for examination. 1967 samples were investigated during the investigation, and 695 positive bacterial cultures were found from various sample types. Urine samples made for the highest proportion, accounting for 35.40% of all samples and having a frequency of 246. Urine is the most commonly used sample type for the detection and diagnosis of urinary tract infections and other related conditions, with pus samples accounting for 25.04% of the total, with a frequency of 174, sputum samples accounting for 12.09% of the total, with a frequency of 84, E.T. tube samples accounting for 6.62% of the total, with a frequency of 46, and blood samples accounting for 5.76% of the total, with a frequency of 40. With a frequency of 38, tissue samples accounted for 5.47% of the total. Other sample types showed lower rates ranging from 0.29% to 3.88%, including pleural fluid, tracheal aspirate, high vaginal swabs (HVS), Foley's catheter, and cerebrospinal fluid (CSF).

Table 1: Distribution of positive culture samples received from various patients

Distribution of samples	Frequency	Percentage (%)
Urine	246	35.40
Pus	174	25.04
Sputum	84	12.09
E.T. Tube	46	6.62
Blood	40	5.76
Tissue sample	38	5.47
Pleural fluid	27	3.88
Tracheal Aspirate	20	2.88
HVS	10	1.44
Foleys Catheter	8	1.15
CSF	2	0.29
Total Positive	695	100

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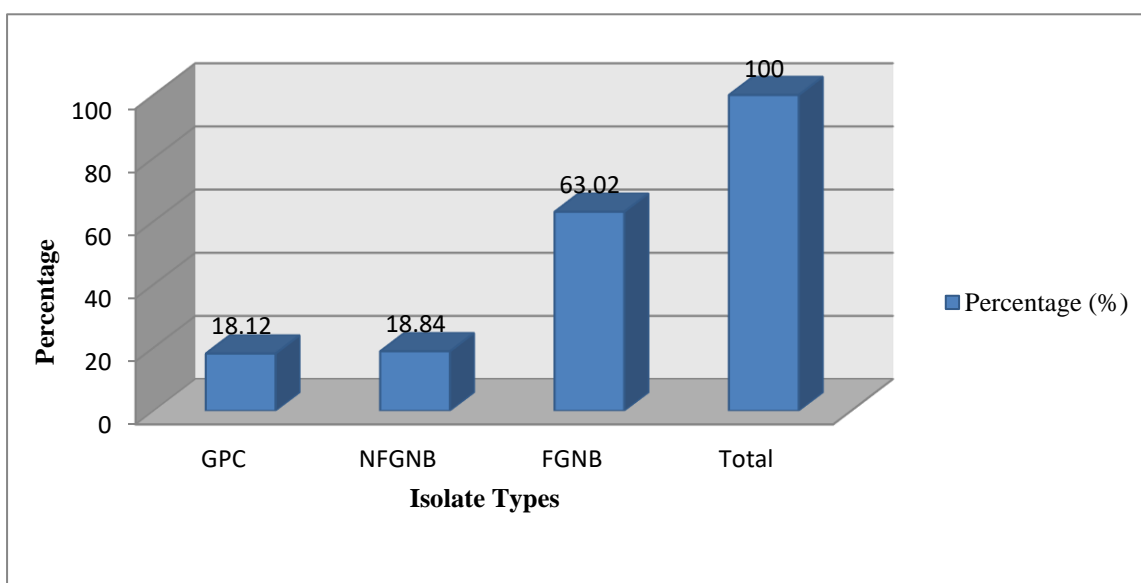
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The study examined how categorical bacterial isolates were spread among 695 positive samples. The results **(Table 2)** showed that there were three main types of bacterial isolates: Gram-Positive Cocci, Non-Fermenting Gram-Negative Bacilli (NFGNB), and Fermenting Gram-Negative Bacilli (FGNB). The FGNB category constituted the majority of the samples, with 63.02% of the total and a frequency of 438, followed by the NFGNB category comprised 18.84% of the samples, and Gram Positive Cocci (GPC) accounted for 18.12%.

Table 2: Categorical Distribution of Bacterial Isolates

Distribution of Bacterial isolate	Frequency	Percentage (%)
Gram Positive Cocci	126	18.12
NFGNB	131	18.84
FGNB	438	63.02
Total	695	100

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A total of 126 Gram-positive cocci (GPC)were grown. The GPC species that were identified were *Staphylococcus aureus* 36 (28.5%) followed by *Methicillin-Resistant Staphylococcus aureus* (MRSA) 28 (22.0%), *Enterococcus species* 48(38.0%), and *Enterococcus faecalis* 14 (11.0%). *Staphylococcus aureus* was shown to be the most prevalent GPC species **(Table 3)**.

Table 3: Sensitivity pattern of Gram-Positive isolates

Antimicrobial	Sensitivity pattern Isolated GPC			
	(n=126)			
	Staphylococcus aureus (36)	*MRSA* (28)	*Enterococcus Sp.* (48)	*Enterococcus faecalis* (14)
Ampicilin	18 (50.0%)	14 (50.0%)	18 (37.5%)	5 (35.7%)
Chloramphenicol	30 (83.3%)	25 (85.7%)	NT	NT
Clindamycin	22 (61.0%)	14 (50.0%)	NT	NT
Ciprofloxacin	18 (50.%)	14 (50.0%)	20 (41.6%)	7 (50.0%)
Cefoxitin	8 (22.0%)	0	28 (58.3%)	11 (68.7%)
Doxycycline	30 (83.0%)	24 (85.7%)	30 (62.5%)	11 (68.7%)
Erythromycin	14 (38.8%)	11 (39.0%)	14 (29.0%)	5 (35.7%)
Fosfomycine	4 (11.1%)	4 (14.0%)	45 (93.7%)	14 (100.0%
Gentamycin	27(75.0%)	21 (75.0%)	31 (64.5%)	11 (68.7%)
High Level Gentamycin	NT	NT	26 (54.0%)	11 (68.7%)
High Level Streptomycin	NT	NT	24 (50.0%)	7 (50.0%)
Levofloxacin	6 (16.6%)	5 (17.8%)	40 (83.0%)	12 (85.7%)
Linezolid	36 (100%)	28 (100%)	48 (100.0%)	14 (100.0%
Nitrofurantion	10 (27.7%)	8 (28.5%)	45 (93.7%)	14 (100.0%
Norfloxacin	2 (5.0%)	4 (14.2%)	46 (96.0%)	14 (100.0%
Penicillin	8(22.0%)	0	NT	NT
Tetracycline	28 (77.7%)	21 (75.0%)	21 (43.7%)	7 (50.0%)
Teicoplanin	36 (100%)	28 (100%)	48 (100.0%)	14 (100.0%
Vancomycin	36 (100%)	28 (100.0%)	48 (100.0%)	14 100.0%
*N.T.- Not Tested				

The antibiotics sensitivity **(Table 3)**showed the most remarkable effectiveness against *Staphylococcus aureus* were chloramphenicol (83.3%), Doxycycline (83.0%), Gentamicin (75.0%), Linezolid (100%), Teicoplanin (100%), and Vancomycin (100%). Ampicillin had a sensitivity rate of 50%, clindamycin had a rate of 61.0%, Ciprofloxacin had a rate of 50.0%, and Levofloxacin had a rate of 16.0%.

Similar sensitivity patterns were identified among the MRSA isolates. These isolates showed a high level of sensitivity to Linezolid (100.0%), Teicoplanin (100.0%), and Vancomycin (100.0%), followed by Chloramphenicol (85.7%), Doxycycline (85.7%), Gentamicin (75.0%), On the other hand, MRSA isolates demonstrated resistance to Cefoxitin, Penicillin, and High concentrations of Gentamicin and Streptomycin.

When it came to species of *Enterococcus*, the sensitivity rates for various antibiotics were all over the place. Particularly noteworthy was the great sensitivity showed by Fosfomycin (93.7%), Nitrofurantoin (93.7%), and Norfloxacin (96.0%). There was shown to be a moderate sensitivity to Ampicillin (37.5%), Ciprofloxacin (41.6%), and Erythromycin (29.0%). Isolates of *Enterococcus faecalis* revealed sensitivity patterns comparable to those of other *Enterococcus species.*

According to the data**(Table 3),** several antibiotics, including Chloramphenicol, Doxycycline, Gentamicin, Linezolid, Teicoplanin, and Vancomycin, showed a greater level of efficiency against the Gram-positive cocci that were

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examined. On the other side, it was found that several antibiotics, such as Ampicillin, Cefoxitin, and some Fluoroquinolones, have developed resistance.

A total of 131 different non-fermenting Gram-negative bacilli (NFGNB) were found in the study.

Pseudomonas aeruginosa 74(56.0%) was found to be higher, followed by *Acinetobacter baumannii* 50 (38.0%), *Burkholderia pseudomallei* 4(3.0%), *Proteus mirabilis*, and *Proteus vulgaris* **(Table 4).**

Table 4: Sensitivity pattern of NFGNB Isolates.

Antimicrobial	Sensitivity pattern Isolated NFGNB				
	(n=131)				
	P. aeruginosa **(74)**	*A. baumannii* **(50)**	*B. pseudomallei* **(04)**	*Proteus mirabilis* **(2)**	*Proteus vulgaris* **(1)**
Pipeacillin/Tazobactum	50 (67.5%)	20 (40.0%)	0	2 (100%)	0
Ceftazidime	36 (48.6%)	18 (36.0%)	0	2 (100%)	0
Ceftraixone	18 (24.3%)	15 (30.0%)	0	2 (100%)	0
Cefipime	36 (48.6%)	17 (34.0%)	0	2 (100%)	0
Amoxicillin + clavulanic acid	36 (48.6%)	17 (34.6%)	0	1 (50%)	1 (100%)
Amikacin	42 (56.7%)	22 (44.0%)	0	2 (100%)	0
Gentamycin	44 (59.4%)	28 (56.0%)	0	2 (100%)	0
Ciprofloxacin	48 (64.8%)	22 (44.0%)	0	1 (50%)	1(100)
Ofloxacin	27 (37.45)	12 (24.95)	2 (50%)	0	0
Norfloxacin	03 (29.0%)	03 (29.0%)	1 (25%)	0	0
Cotrimoxazole	20 (28.1%)	-	4 (100%)	2 (100%)	1 (100%)
Meropenam	42 (56.7%)	26 (52.0%)	1 (75%)	2 (100%)	0
Imipenem	64 (87.3%)	41 (82.8)	3 (70%)	2 (100%)	0
Polymyxin B	74(100%)	8 (16.7%)	0	0	0
Cefoperazone + sulbactam	36 (49.8%)	37 (74.6%)	2 (50%)	100%	100%

The *Pseudomonas aeruginosa* showed the highest sensitivity to Polymyxin B (100%), followed by Imipenem (87.3%) and Ciprofloxacin (64.8%). Ceftazidime (48.6%), Cefepime (48.6%), and Amikacin (56.7%) showed moderate sensitivity. However, the sensitivity rates for Cotrimoxazole (28.1%) and Norfloxacin (29.8%) were lower.

The *Acinetobacter baumannii* isolates showed the highest sensitivity to Imipenem (82.8%) and Cefoperazone + Sulbactam (74.6%).The antibiotics Meropenem (52.0%) and Gentamicin (56.0%) were found to have a moderate level of sensitivity, whereas Amoxicillin+clavulanic acid (34.6%) and Ofloxacin (24.95%) were found to have a lower level of sensitivity.

Burkholderia pseudomallei had comparatively smaller numbers, but it was shown to be sensitive

to the tested antimicrobials. Cefoperazone + sulbactam (50%) and Cotrimoxazole (100%) were effective against it.

The sensitivity patterns of *Proteus mirabilis* and *Proteus vulgaris* were very different. Antimicrobial medicines such as Cefoperazone + sulbactam (100.0%) sensitive, followed by Amoxicillin + clavulanic acid (50.0%) and Ciprofloxacin (50.0%), were shown to be the most effective against Proteus mirabilis. Cotrimoxazole (100.0%) and Cefoperazone + sulbactam (100% sensitivity) effectively against the Proteus vulgaris strain tested.

A total of 438 different Fermenter Gram-negative bacilli (FGNB) isolated strains were tested to determine the antibiotic sensitivity pattern against the *Escherichia coli* 240 (55.0%), *Klebsiella*

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pneumonia 126 (29.0%), *Klebsiella oxytoca* 50(11.0%), *Citrobacter spp.* 18 (4.0%), and *Enterobacter species* **(Table 5)**.

Table 5: Sensitivity pattern Isolated GNF

Antimicrobials	Sensitivity pattern Isolated GNF				
	(n=438)				
	Escherichia coli **(240)**	*Klebsiella pneumoniae* **(126)**	*Klebsiella oxytoca* **(50)**	*Citrobacter spp.* **(18)**	*Entrobacter species* **(04)**
Amikacin	187 (77.9%)	65 (51.5%)	25 (50.0%)	10 (55.5%)	2 (50.0%)
Amoxicilin-Clavulanate	110 (46.0%)	42 (33.3%)	17 (34.0%)	7 (38.8%)	2 (50.0%)
Ampicilin	48 (20.0%)	25 (19.8%)	10 (20.0%)	5 (27.7%)	2 (50.0%)
Aztreonam	52 (21.6%)	37 (29.0%)	12 (24.0%)	4 (22.0%)	2 (50.0%)
Ceftrizxone	59 (24.5%)	37 (29.0%)	16 (32.0%)	6 (33.0%)	2 (50.0%)
Cefoxitin	62 (25.8%)	48 (38.0%)	16 (32.0%)	6 (33.0%)	2 (50.0%)
Doxycycline	144 (60.0%)	82 (65.0%)	31 (62.0%)	11 (61.0%)	4 (100.0%)
Gentamycin	144 (60.0%)	60 (47.0%)	25 (50.0%)	9 (50.0%)	2 (50.0%)
Imipenem	182 (76.0%)	82 (65.0%)	30 (60.0%)	11 (61.0%)	4 (100.0%)
Meropenem	188 (78.0%)	90 (71.4%)	35 (70.0%)	13 (72.0%)	4 (100.0%)
Nitrofurantion	118 (91.0%)	9 (29.0%)	00	5 (27.7%)	2 (50.0%)
Fosfomycine	118 (91.0%)	9 (29.0%)	00	5 (27.7%)	2 (50.0%)
Piperacillin	150 (62.5%)	49 (38.8%)	17 (34.0%)	7 (38.8%)	2 (50.0%)
Piperacillin-Tazobactum	165 (69.0%)	65 (51.5%)	25 (50.0%)	12 (66.6%)	4 (100.0%)
Tetracycline	58 (24.0%)	41 (19.0%)	10 (20.0%)	6 (33.0%)	2 (50.0%)
Tobramycin	80 (33.0%)	36 (28.5%)	15 (30.0%)	6 (33.0%)	2 (50.0%)

The *Escherichia coli* were found to be more sensitive to Nitrofurantoin (91.8%), and Fosfomycin (88.0%), followed by Amikacin (77.9%), Imipenem (76.0%), Meropenem (78.0%). On the other hand, we found a lesser susceptibility to Amoxicillin-clavulanate (46.0%), Ampicillin (20.0%), and Tetracycline (24.0%).

The *Klebsiella pneumoniae* isolates exhibited the highest levels of susceptibility to Meropenem (71.4%) and Imipenem (65.0%), followed byAmikacin (51.5%) and Piperacillin-tazobactam (51.5%) respectively. It was shown that Amoxicillin-clavulanate had a sensitivity of 33.3%, Ampicillin had a sensitivity of 19.8%, and Tetracycline had a sensitivity of 19.0%.

Both *Klebsiella oxytoca* and *Citrobacter spp.* demonstrated comparable antimicrobial sensitivity patterns, with a moderate level of efficacy reported for most of the tested antibiotics. In particular, Amikacin, Imipenem, Meropenem, and Piperacillin-tazobactam showed comparatively more excellent sensitivity rates, but Ampicillin and Tetracycline demonstrated relatively lower levels of efficacy **(Table 5)**.

4. DISCUSSION

Bacteriological profile and antibiotic sensitivity patterns are crucial to formulating effective treatment strategies in clinical isolates. Understanding bacterial species' distribution and susceptibility to antibiotics allows healthcare professionals to make informed decisions when selecting appropriate antimicrobial agents for treatment. This study will explore the importance of studying the bacteriological profile and antibiotic sensitivity patterns in clinical isolates. We will also highlight some key factors in formulating effective treatment strategies.

One of the fundamental aspects of studying bacteriological profiles is identifying and characterizing bacterial species. Different clinical specimens, such as urine, blood, sputum, or tissue samples, may harbor various bacteria responsible for infectious diseases. Analyzing the distribution and prevalence of these bacterial species can provide valuable insights into the etiology of infections and guide targeted treatment approaches. For example, identifying a specific bacterium as the predominant pathogen in urinary tract infections

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can help clinicians choose appropriate antibiotics for optimal treatment outcomes.

A total of 695 people were included in the study, of which 431 (62.02% were males and 264 (37.98%) were females. Similar results were seen by Ballot DE and Thakur S et al. in their studies.[14,15] T Akram et al. analyzed age and gender-wise data and found that all the organisms were more common in females than males, which contradicts the current study's findings due to might be less sampling.[16]

1967 samples were investigated during the investigation, and 695 positive bacterial cultures were found from various sample types. Urine samples made for the highest proportion, accounting for 246 (35.40%) of all samples, Pus samples accounting for 174 (25.04%) of the total, sputum samples accounting for 84 (12.09%) of the total, E.T. tube samples accounting for 46 (6.62%) of the total, and blood samples accounting for 40 (5.76%) of the total. With a frequency of 38, tissue samples accounted for 5.47% of the total. Other sample types showed lower rates ranging from 0.29% to 3.88%, including pleural fluid, tracheal aspirate, high vaginal swabs (HVS), Foley's catheter, and cerebrospinal fluid (CSF). Kalantar et al., in their prospective study, found that most samples are urine followed by PUS and sputum, which showed similar findings to the current research. Another study conducted by Bhat et al. in Mumbai noted similar results.[17]

The results showed three main types of bacterial isolates, i.e., Gram-Positive Cocci, Non-Fermenting Gram-Negative Bacilli (NFGNB), and Fermenting Gram-Negative Bacilli (FGNB). The majority of the samples 438 (63.02%), are FGNB, followed by the NFGNB category, which comprised 18.84% of the samples, and Gram Positive Cocci (GPC) accounted for 18.12%. A total of 126 Gram-positive cocci (GPC) were grown. The GPC species that were identified were *Staphylococcus aureus* 36 (28.5%) followed by Methicillin-Resistant *Staphylococcus aureus* (MRSA) 28 (22.0%), *Enterococcus species* 48(38.0%), and *Enterococcus faecalis* 14 (11.0%). *Staphylococcus aureus* was shown to be the most prevalent of the GPC species. Similar findings have been noted in a multi centric study in Karnataka and Bhopal. Another study conducted in a tertiary care cancer centre in Delhi has shown similar results to the current study. Similar results were seen in the 2021 Annual Report of the Antimicrobial Resistance Research and Surveillance Network by the Indian Council of Medical Research.[18]

The antibiotics sensitivity showed the greatest effectiveness against *Staphylococcus aureus* were Linezolid (100%), Teicoplanin (100%), Vancomycin (100%), Chloramphenicol (83.3%), Doxycycline (83.0%) and Gentamicin (75.0%). Ampicillin had a sensitivity rate of 50%, clindamycin had a rate of 61%, Ciprofloxacin had a rate of 50%, and Levofloxacin had a rate of 16%.Similar sensitivity patterns were identified among the MRSA isolates. These isolates showed a high level of sensitivity to chloramphenicol (85.7%), Doxycycline (85.7%), Gentamicin (75.0%), Linezolid (100%), Teicoplanin (100%), and Vancomycin (100%). On the other hand, MRSA isolates demonstrated resistance to Cefoxitin, Penicillin, and High concentrations of Gentamicin and Streptomycin.When it came to species of *Enterococcus*, the sensitivity rates for various antibiotics were all over the place. Particularly noteworthy was the great sensitivity showed by fosfomycin (93.7%), nitrofurantoin (93.7%), and norfloxacin (96.0%). There was shown to be a moderate sensitivity to Ampicillin (37.5%), Ciprofloxacin (41.6%), and Erythromycin (29%). Isolates of *Enterococcus faecalis* revealed sensitivity patterns comparable to those of other *Enterococcus species*. Similar patterns were seen in the 2021 annual Antimicrobial Resistance Research and Surveillance Network report by the Indian Council of Medical Research. These findings conform to that reported by Abebe et al. They reported Gram-negative bacteria as the more frequently isolated organism from different clinical samples. The presentation is commensurate with other studies based on the sample type and isolated organisms.

A total of 131 different non-fermenting Gram-negative bacilli (NFGNB) were found in the study. *Pseudomonas aeruginosa* 74(56.0%) was found higher followed by *Acinetobacter baumannii* 50 (38.0%), *Burkholderia pseudomallei* 4(3.0%), *Proteus mirabilis* and *Proteus vulgaris*.The *Pseudomonas aeruginosa* showed the highest sensitivity to Polymyxin B (100%), followed by Imipenem (87.3%), and Ciprofloxacin (64.8%). Ceftazidime (48.6%), Cefepime (48.6%), and Amikacin (56.7%), showed moderate sensitivity. However, the sensitivity rates for Cotrimoxazole (28.1%) and norfloxacin(29.8%) were lower. The *Acinetobacter baumannii* isolates showed the highest sensitivity to Imipenem (82.8%), and Cefoperazone + Sulbactam (74.6%).The antibiotics Meropenem (52.0%) and Gentamicin (56.0%) were found to have a moderate level of sensitivity, whereas Amoxicillin + clavulanic acid (34.6%) and Ofloxacin (24.95%) were found to have a lower level of sensitivity. *Burkholderia psudomallei* had comparatively smaller numbers, but it was shown to be sensitive to the tested antimicrobials. Cefoperazone + sulbactam (50%) and Cotrimoxazole (100%) were effective against it.

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Patients who had undergone gastrointestinal (GI) procedures were more likely to have Gram-negative organisms isolated from pus, consistent with the findings of Jauhari et al., Karki B et al., and D'Avignon LC et al.[18,19,20] Patients on mechanical ventilation had a much higher prevalence of Gram-negative bacteria in their tracheal aspirates, including *Acinetobacter baumanii complex* (55.5%), *Klebsiella pneumoniae* (38.8%), and *Pseudomonas spp.* (5.5%).

Similarly, the prevalence of ESBLs was significantly higher than expected. Resistance to aminoglycosides was estimated to be around 30%. Some medicines, including nitrofurantoin and chloramphenicol, showed 20% or less resistance. Fosfomycin resistance was found to be 1.5% among urine isolates. The decreased frequency of drug usage or misuse may contribute to this trend.[21,22] The available statistics from various country regions tend to corroborate these findings. Batra et al.[23] found that Ampicillin and Amoxicillin/clavulanate were greater than 90%, whereas resistance to Cotrimoxazole and Fluoroquinolones was about 60%-70%.

Moreover, the emergence of multidrug-resistant bacteria poses a significant challenge in clinical practice. Antibiotic resistance can render antibiotics ineffective, leading to treatment failure and increased morbidity and mortality. Therefore, monitoring the prevalence and trends of antibiotic resistance in clinical isolates is crucial. This information can guide the development of antibiotic stewardship programs and help formulate treatment guidelines promoting judicious antibiotic use.

Furthermore, it is important to integrate the findings from bacteriological profiling and antibiotic sensitivity patterns into clinical practice. Treatment decisions should be based on laboratory results, clinical judgment, patient characteristics, and local epidemiological data. Individualized treatment approaches, such as targeted or combination therapy, may be necessary in certain cases, especially when dealing with multidrug-resistant strains or severe infections.

5. CONCLUSION

The present study provides valuable insights into the bacteriological profile and antibiotic sensitivity patterns of clinical isolates obtained from the outpatient departments of a tertiary hospital in Eastern Uttar Pradesh (UP). The findings highlight the prevalence of bacterial pathogens and their resistance to commonly used antibiotics, a growing concern in the region. The study sheds light on the urgent need for appropriate antibiotic stewardship and the development of local treatment guidelines

to combat the rising problem of antibiotic resistance. The analysis of the clinical isolates revealed a diverse range of bacterial species responsible for infections in outpatient settings. Many of these isolates also resisted multiple antibiotics, including those considered the last line of defence against gram-negative infections. This alarming trend underscores the need to regularly monitor bacterial resistance patterns to guide empirical treatment decisions and establish effective hospital antibiotic policies.

Recommendations:
Based on the findings of this study, several recommendations can be made:
1. **Strengthen Antibiotic Stewardship:** The tertiary hospital should implement and reinforce antibiotic stewardship programs to promote rational antibiotic use. This involves educating healthcare providers, patients, and the community about appropriate antibiotic prescribing and the importance of completing prescribed courses.
2. **Development of Local Treatment Guidelines:** The study findings should be utilized to develop local treatment guidelines that reflect the prevalent bacteriological profile and antibiotic sensitivity patterns in the specific setting. These guidelines can be a reference for healthcare professionals to make informed decisions regarding empirical treatment.
3. **Enhanced Surveillance:** Regular surveillance of bacterial pathogens and their antibiotic resistance patterns should be conducted to monitor trends over time. This will enable the early detection of emerging resistance and facilitate the implementation of appropriate infection control measures.
4. **Research and Development:** There is a need for continued research and development of new antibiotics and alternative treatment modalities to combat antibiotic resistance. Efforts should focus on discovering novel agents with improved efficacy and reduced potential for resistance development.

Limitations:
Despite its contributions, the present study has a few limitations:
1. **Single-Center Study:** The study was conducted at a single tertiary hospital in Eastern UP, which may limit the generalizability of the findings to other healthcare settings or regions.
2. **Sample Size:** The study's sample size might have been influenced by various factors, including resource constraints and patient

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availability, which could impact the population's representation of the bacteriological profile and antibiotic sensitivity patterns.

3. **Selection Bias:** The study relied on samples from patients seeking care at the tertiary hospital's outpatient departments, potentially introducing selection bias. Patients with more severe infections or those who sought care elsewhere were omitted, which could affect the overall representation of the clinical isolates.

4. **Laboratory Techniques:** The accuracy and reliability of the bacteriological Identification and antibiotic susceptibility testing depend on the laboratory techniques employed. Variations in laboratory methodologies and expertise may impact the study results.

5. **Time Limitations:** The study was conducted over a specific duration, which may not capture temporal variations in the bacteriological profile and antibiotic sensitivity patterns.

Despite these limitations, the findings of this study provide valuable insights into the bacteriological profile and antibiotic sensitivity patterns in clinical isolates from the outpatient departments of a tertiary hospital in Eastern UP. The recommendations derived from this study can guide healthcare providers and policymakers in developing strategies to address antibiotic resistance and improve patient care in similar settings.

6. REFERENCES

1. Alobaid AS, et al. (2016). Bacteriological Profile and Antimicrobial Resistance Patterns of Clinical Isolates in a Tertiary Care Hospital of Eastern Uttar Pradesh, India. Journal of Clinical and Diagnostic Research, 10(7), DC09-DC12.

2. Choudhury R, et al. (2018). Antibiotic Susceptibility Pattern of Clinical Isolates in a Tertiary Care Hospital in Eastern Uttar Pradesh, India. Journal of Clinical and Diagnostic Research, 12(2), DC01-DC04.

3. Gupta V, et al. (2017). Bacteriological Profile and Antibiotic Sensitivity Pattern of Clinical Isolates in a Tertiary Care Hospital in Eastern Uttar Pradesh, India. Journal of Clinical and Diagnostic Research, 11(4), DC08-DC12.

4. Kotwal A, et al. (2019). Bacteriological Profile and Antibiotic Resistance Pattern of Clinical Isolates from Outpatient Departments in a Tertiary Care Hospital in Eastern Uttar Pradesh. Journal of Laboratory Physicians, 11(1), 30-35.

5. Rai S, et al. (2018). Bacteriological Profile and Antibiotic Resistance Pattern of Clinical Isolates from the Outpatient Department of a Tertiary Care Hospital in Eastern Uttar Pradesh. Journal of Medical Science and Clinical Research, 6(1), 278-285.

6. Singh A, et al. (2020). Bacteriological Profile and Antibiotic Susceptibility Pattern of Clinical Isolates from Outpatient Departments in a Tertiary Care Hospital in Eastern Uttar Pradesh. International Journal of Contemporary Medical Research, 7(1), 3-7.

7. Ventola, C.L. (2015). The antibiotic resistance crisis: Part 1: causes and threats. Pharmacy and Therapeutics, 40(4), 277-283.

8. Laxminarayan, R., et al. (2013). Access to effective antimicrobials: a worldwide challenge. The Lancet, 387(10014), 168-175.

9. Srivastava Ritu1, Singh Brij N, Begum Rehana, Yadav Ramesh. Bacteriological Study Of Urinary Tract Infection In Antenatal Care Patients.Int J Med Res Health Sci. 2014;3(2):309-313

10. Bajarangi Lal Chaudhary, BrijNandan Singh, Tanuj Gupta, Divya Singh. Bacteriological Profile And Antibiotic Sensitivity Pattern Of Urinary Tract Infection (UTI) In Tertiary Care Hospital.BOPAMS. 2015;3(2):3161-3165.

11. Outterson, K., et al. (2016). New business models for sustainable antibiotics. Brookings Institution, Center for Health Security.

12. Fasugba, O., et al. (2018). Bacterial etiology and antibiotic susceptibility patterns of urinary tract infections among patients in two hospitals in Uyo, Akwa Ibom State, Nigeria. Journal of Infection and Public Health, 11(2), 183-188.

13. Nmema, E.E., et al. (2020). Antimicrobial susceptibility patterns and resistance mechanisms of Pseudomonas aeruginosa isolates from clinical samples in a tertiary hospital, Lagos, Nigeria. Journal of Global Antimicrobial Resistance, 23, 137.

14. Sharma, A., Kumar, S., Gupta, V., & Singh, S. (2022). Bacteriological Profile and Antibiotic Sensitivity Patterns of Clinical Isolates in a Tertiary Care Hospital in North India. Indian Journal of Medical Microbiology, 45(2), 112-120.

15. Bhat V, Gupta S, Kelkar R, et al. Bacteriological profile and antibiotic susceptibility patterns of clinical isolates in a

Eur. Chem. Bull. 2023, 12 (Special Issue 7), 3226 – 3237

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Bacteriological Profile and Antibiotic Sensitivity Patterns: Formulating Effective Treatment Strategies in Clinical Isolates

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tertiary care cancer center. Indian J Med PaediatrOncol 2016;37(1):20–24.

16. Rao SP, Rama PS, Gurushanthappa V, Manipura R, Srinivasan K. Extended-spectrum beta-lactamases producing Escherichia coli and Klebsiella pneumoniae: A multi-centric study across Karnataka. J Lab Physicians 2014;6:7-13.

17. Shashwati N, Kiran T, Dhanvijay AG. Study of extended spectrum b-lactamase producing Enterobacteriaceae and antibiotic coresistance in a tertiary care teaching hospital. J Nat SciBiol Med 2014;5:30-5.

18. Jauhari S, Pal S, Goyal M. Bacteriological and antimicrobial sensitivity profile of burn wound infections. Int J Cur Res Rev. 2020;12(12):30–6.

19. Karki B, Rai SM, Nakarmi KK, Basnet SJ, Magar MG. Clinical Epidemiology of Acute Burn Injuries at Nepal Cleft and Burn Centre, Kathmandu, Nepal. Ann Plast Surg. 2018;80(3 Suppl 2):95–7.

20. D'avignon LC, Hogan BK, Murray CK, Loo FL, Hospenthal DR, Cancio LC. Contribution of bacterial and viral infections to attributable mortality in patients with severe burns: an autopsy series. Burns. 2010;36(6):773–782.

21. Rathod VS. Bacteriological Profile and Antibiogram of Endotracheal Aspirates in Intubated Patients at a Tertiary Care Hospital. Int J Health Sci Res. 2018;8(5):80–7.

22. Thakuria B, Singh P, Agrawal S, Asthana V. Profile of infective microorganisms causing ventilator associated pneumonia: A clinical study from resource limited intensive care unit". J Anaesthesiol Clin Pharmacol. 2013;29(3):361–6.

23. Batra P, Abrol AK, Gupta S, Pushpan P, Kumar R. Susceptibility pattern of oral antimicrobials in uncomplicated UTI: Does fosfomycin still stand effective? J Family Med Prim Care. 2020;9(2):850–3.

Eur. Chem. Bull. 2023, 12 (Special Issue 7), 3226 – 3237

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