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PREVALENCE AND ANTIBIOGRAM OF BACTERIAL PATHOGENS ISOLATED FROM PATIENTS PRESENTING WITH NOSOCOMIAL INFECTIONS AT ALEX EKWUEME FEDERAL UNIVERSITY TEACHING HOSPITAL ABAKALIKI

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ABSTRACT

This study was aimed at determining the prevalence and antibiogram of bacterial isolates implicated in nosocomial infections among hospitalized patients at Alex Ekwueme Federal University Teaching Hospital Abakaliki Ebonyi State. A total of 120 (blood/urine) samples were collected from male and female patients that are on admission in the various hospital wards. The samples were analyzed bacteriologically using standard microbiological techniques for isolation and identification of the isolates. Antibiotics susceptibility testing was done against different classes of antibiotics using Kirby-Bauer disc diffusion method and multiple antibiotic resistance index (MARI) were determined. Out of the 120 samples analyzed, the overall prevalence of bacteria isolates was reported to be 71 (59.2%). The bacteria isolate that were identified from the samples analyzed includes *E. coli* 26 (21.7%), *Staphylococcus* spp. 17 (14.2%), *Pseudomonas* spp. 16 (13.3%) and *Klebsiella* spp 12 (10.0%). Exactly, 34 (58.6%) samples were positive for the bacteria isolates from male and 37 (59.7%) were positive for female patients. Ceftriaxone were highly susceptibility to *E. coli*. *Staphylococcus* spp isolated from both blood and urine samples have susceptibility range of 12.5% to 33.3%. *Pseudomonas* spp isolated from both samples showed relatively moderate level of resistance against gentamycin, ceftriaxone, ciprofloxacin, amoxicillin and tetracycline from 16.7% to 66.6%. *Klebsiella* spp isolated from urine showed high level of resistance to gentamicin (75.0%) and moderate resistance was observed in isolates from both samples to other tested antibiotics which includes amoxicillin, ciprofloxacin, ceftriaxone and tetracycline with resistance of 25.0% to 62.5%. The MARI value of the bacteria isolates was observed among the *E. coli* (MARI - 0.6), *Staphylococcus* spp. (MARI - 0.5), *Pseudomonas* spp. (MARI - 0.4) and *Klebsiella* spp. (MARI - 0.7). The average MARI reported among the bacteria isolates was 0.5. In conclusion, presence of multidrug resistance *E. coli*, *Staphylococcus* spp., *Pseudomonas* spp., and *Klebsiella* spp. were reported among patients admitted in various wards at Alex Ekwueme Federal University Teaching Hospital Abakaliki. We therefore recommend stringent antibiotic administration policies for patients and continuous surveillance on the emergence of antimicrobial resistance in the hospital environment.

KEYWORDS: Antimicrobial resistance; Nosocomial; Infections; Bacteria; Patients.

1. INTRODUCTION

Nosocomial infections, also known as hospital-acquired infections (HAIs), are infections that patients acquire during their stay in a healthcare facility, which were neither present nor incubating at the time of admission (WHO, 2011). Various studies identified HAIs as those infections acquired in hospital or healthcare service unit, that appear 48 hours or more after hospital admission or within 30 days after discharge following in-patient care and is unrelated to the hospital illness that brought the patient to the clinic (Avershina *et al.*, 2021; Lobdell *et al.*, 2012). These infections pose a significant challenge in healthcare settings due to their impact on patient morbidity, mortality, and the overall cost of healthcare (Allegranzi *et al*., 2011). The prevalence of nosocomial infections is concerning, as they are associated with prolonged hospital stays, increased medical expenses, and, in severe cases, life-threatening complications (Magill *et al*., 2018). Consequently, nosocomial infections remain a critical concern for healthcare providers and policy makers worldwide. Nosocomial infections are underscored by their ability to affect a substantial number of patients across various healthcare environments, from general hospitals to specialized care units (Haque *et al*., 2018). Their prevalence is particularly high in intensive care units (ICUs) and surgical wards, where patients are often more susceptible due to compromised immune systems or invasive procedures (Laxminarayan *et al*., 2013). Investigating the prevalence of nosocomial infections is crucial for understanding the scope of the problem, identifying high-risk areas, and implementing effective infection control measures to safeguard patient health (Friedman *et al*., 2017).

Bacterial pathogens are the primary culprits in nosocomial infections. Commonly implicated bacterial species include *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Acinetobacter baumannii* (Magill *et al*., 2014). These pathogens are often transmitted through direct contact with contaminated surfaces, healthcare workers, or other patients. The ability of these bacteria to persist in hospital environments and their potential to cause severe infections make them a significant threat to patient safety. Nosocomial infections are particularly concerning because they are often caused by antibiotic-resistant bacteria. Hospitals are environments where high antibiotic use, vulnerable patient populations, and close quarters create ideal conditions for the development and spread of resistant organisms (Magill *et al*., 2014). The increasing prevalence of antibiotic-resistant bacteria in healthcare settings has compromised the effectiveness of standard treatments, leading to more severe health outcomes, prolonged hospital stays, and increased healthcare costs.

Drug resistance has been greatly accelerated by the widespread and often inappropriate use of antibiotics in both healthcare and agriculture (Davies and Davies, 2010). Some bacteria produce enzymes, such as β-lactamases, that break down antibiotics or modify the sites within their cells that antibiotics typically target, such as altering penicillin-binding proteins, leading to resistance as seen in *Methicillin-resistant Staphylococcus aureus* (MRSA) (Bush and Jacoby, 2010; Foster, 2017;). Certain bacteria have developed efflux pumps, which actively expel antibiotics from the bacterial cell, lowering the concentration of the drug inside the cell and reducing its effectiveness (Li *et al*., 2015). Bacteria can acquire these resistance genes from other bacteria through horizontal gene transfer mechanisms like conjugation, transformation, or transduction. This allows for the rapid spread of resistance traits within and between bacterial populations especially in a hospitalized situations (Munita and Arias, 2016). At AE-FUTHAI, there is a need for continuous research and updated data on bacterial isolates responsible for nosocomial infections and their resistance profiles, as microorganisms constantly acquire resistance genes, posing challenges to effective treatment and infection control strategies.

2. MATERIALS AND METHOD

Study area

The study was conducted at the Alex Ekwueme Federal University Teaching Hospital Abakaliki (AE-FUTHAI) located along Abakaliki-Enugu road. It is a tertiary healthcare facility serving a large patient population in southeastern Nigeria. Abakaliki is the capital city of Ebonyi State in southeastern Nigeria. It is located at approximately 6.3274° N latitude and 8.1137° E longitude.

The inhabitants include mostly farmers, traders and civil servants.

Ethical clearance

The ethical approval for the study was obtained from the ethical clearance committee of AE-FUTHA Abakaliki, Ebonyi State.

Inclusion and exclusion criteria

Patients included in the study were those who had been hospitalized for more than 48 hours and who were suspected to exhibit symptoms consistent with nosocomial infections, as defined by the Centers for Disease Control and Prevention (CDC) criteria for healthcare-associated infections (Lobdell *et al*., 2012). Patients who were discharged within 48 hours or had infections present on admission were excluded from the study.

Sample collection

The patients included in the study were those admitted to various departments including intensive care units (ICU), surgical wards, medical wards, and pediatrics wards, where patients are often admitted for a period of time. A total of 120 study populations were considered for the study and a random sampling technique was employed for sample collection. Thirty (30) samples of early morning midstream urine and 5ml of blood (fifteen each) were randomly collected from male and female patients each in the wards. Sterile urine bottles and EDTA containers were used for both urine and blood samples collection respectively. Patients were educated on urine collection while medical staff were engaged for blood collection. Ice pack was used to transport samples to Microbiology Laboratory of Ebonyi State University, Abakaliki for microbial analysis.

Bacteriological analysis

Exactly 1 ml of each sample was cultured at 37°C for 24 hours in test tubes containing 5ml nutrient broth for enrichment. Thereafter, the samples were streaked onto nutrient agar, MacConkey agar and Mannitol salt agar. The culture plates were incubated at 37°C for 24 hours in an incubator. Isolates were sub cultured severally in nutrient agar to obtain a pure culture and stored in the refrigerator for analysis.

Identification of bacterial isolates

Gram staining procedures as well as standard biochemical tests which include catalase test, indole test, mannitol test, oxidase test and coagulase test were carried out for identification of the bacterial isolates (Cheesbrough, 2006).

Antibiotic susceptibility test

The isolates were tested for their susceptibility to various classes of antibiotics using the Kirby – Bauer disc diffusion method. An overnight incubated (37°C) pure culture of each isolate in nutrient broth was adjusted to 0.5 McFarland turbidity. The bacteria isolates were inoculated onto the surface of Mueller-Hinton agar plates, and spread evenly using a sterile glass spreader. Different antibiotics discs were placed on the surface of inoculated plates and incubated at (37°C) for 18-24 hrs. The inhibition zone diameters (IZD) around each antibiotic disk were measured using a calibrated transparent ruler and recorded in millimeters. A standardized CLSI break point table was used to determine if each bacterium was resistant; intermediate; or susceptible (CLSI, 2019). Isolates that showed reduced sensitivity to two or more classes of antibiotic were regarded as multi-drug resistant.

Determination of multiple antibiotic resistance (MAR I) index

Multiple antibiotic resistance (MAR) index was determined using the formula.

MAR = $\frac{a}{b}$

Where *a* is the number of antibiotics to which test isolate displayed resistance and *b* is the total number of antibiotics to which the test organism has been evaluated for sensitivity (Shakir *et al.*, 2021).

3. RESULTS

A total of 71 (59.2%) of pathogenic isolates were recovered from 120 samples of blood and urine collected from patients hospitalized at AE-FUTHAI. Exactly 29 (48.3%) and 42 (70%) isolates were recovered from both blood and urine samples respectively. *E. coli* was the most prevalent organism accounting for 26 (21.7%), *Staphylococcus* spp. 17 (14.2%), *Pseudomonas* spp. 16 (13.3%) and *Klebsiella* spp. had the least at prevalence of 12 (10.0%) (Table 1).

The percentage occurrence of bacterial pathogens in blood and urine samples of male and female patients across different hospital wards shows variations in infection rates by sex and ward type. In the ICU, female patients had a higher infection rate (50%) than males (33.3%). The surgical ward had the most striking disparity, with 100% of female patients testing positive compared to 56.6% of males. In the medical ward, infection rates were similar, with 57.3% for males and 60% for females. The pediatric ward showed the highest male infection rate (91.7%), while females had a lower rate (44%) (Table 2).

Of the wards sampled in AE-FUTHAI, the surgical ward had the highest infection rate (73.3%), followed by the paediatric (63.3%), medical (56.6%), and ICU (43.3%) wards (Table 3). *E. coli* was the most common isolate (16.6% in blood, 26.7% in urine), followed by *Staphylococcus spp.* (8.3% in blood, 20% in urine), *Pseudomonas spp.* (10% in blood, 16.7% in urine), and *Klebsiella spp.* (13.3% in blood, 6.7% in urine). Overall, 59.2% of samples were positive for bacterial isolates, with the highest occurrences in surgical and pediatric wards, highlighting a need for targeted infection control measures (Table 3).

The antibiogram of the recovered *E. coli* isolates were evaluated. *Ceftriaxone* was the most effective, with 100% susceptibility in blood and 75% in urine. *Ciprofloxacin* also showed high effectiveness (80% in blood, 68.8% in urine). *Amoxicillin* had moderate susceptibility (60% in blood, 50% in urine), while *Gentamicin* and *Tetracycline* had the highest resistance rates, especially in urine 67.5% and 81.3%, respectively (Table 4.).

The antibiogram of *Staphylococcus* spp isolated from blood and urine samples shows that *Ceftriaxone* was the most effective antibiotic, with 80% susceptibility in blood and 85% in urine. *Ciprofloxacin* also showed moderate effectiveness, with 60% susceptibility in blood and 66.7% in urine. *Amoxicillin* had moderate effectiveness in blood (60% susceptible) but lower in urine (33.3% susceptible). High resistance rates were observed for *Gentamicin* (60% in blood, 50% in urine) and *Tetracycline* (60% in blood, 66.7% in urine), indicating reduced effectiveness of these antibiotics against *Staphylococcus spp* (Table 5).

In *Pseudomonas* spp *Ciprofloxacin* exhibited the highest effectiveness, with 83.3% susceptibility in blood and 50% in urine. *Ceftriaxone* also showed moderate effectiveness, with 55.6% susceptibility in blood and 70% in urine. *Amoxicillin* had moderate susceptibility in both blood (66.6%) and urine (60%). However, *Gentamicin* and *Tetracycline* demonstrated high resistance rates, with *Gentamicin* showing 66.6% resistance in blood and 70% in urine, while *Tetracycline* had 66.6% resistance in blood and 60% in urine (Table 6).

In *Klebsiella* spp, *tetracycline* was the most effective antibiotic, with 75% susceptibility in both blood and urine samples. *Ciprofloxacin* also showed moderate effectiveness, with 62.5% susceptibility in blood and 50% in urine. *Amoxicillin* had a mixed response, with 50% susceptibility in blood and 75% in urine. High resistance rates were observed for *Ceftriaxone* (62.5% in blood, 50% in urine) and *Gentamicin* (50% in blood, 75% in urine), indicating limited effectiveness of these antibiotics against *Klebsiella* spp (Table 7).

The Multiple Antibiotic Resistance Index (MARI) of the isolated bacterial species were calculated. MARI is a measure of bacterial resistance, calculated by dividing the number of antibiotics a strain is resistant to by the total number of antibiotics tested. *Klebsiella* spp. exhibited the highest MARI (0.7), indicating a high level of resistance to multiple antibiotics. *Escherichia coli* followed with a MARI of 0.6, suggesting significant resistance. *Staphylococcus* spp. had a MARI of 0.5, while *Pseudomonas* spp. showed the lowest resistance (0.4). Overall, the findings indicate that *Klebsiella* spp. and *E. coli* are the most multidrug-resistant among the isolates, raising concerns about treatment options and the need for effective antibiotic stewardship (Table 8).

Table 1: Prevalence of bacterial isolates from blood and urine samples of patients hospitalised at AE-FUTHAI.

Source (no.)	***E. coli* (%)**	***Staphylococcus* spp. (%)**	***Pseudomonas* spp. (%)**	***Klebsiella* spp. (%)**	**Prevalence (%)**
Blood (60)	10(16.6)	5 (8.3)	6 (10)	8 (13.3)	29 (48.3)
Urine (60)	16 (26.7)	12 (20)	10 (16.7)	4(6.7)	42 (70)
Total	**26 (21.7)**	**17 (14.2)**	**16 (13.3)**	**12 (10)**	**71(59.2)**

Table 2: Percentage occurrence of bacterial pathogens in Blood and Urine sample of patients admitted in various wards according to sex.

		Male		**Female**	
Hospital ward	**Sample size**	**No collected**	**No positive (%)**	**No collected**	**No positive (%)**
ICU	30	12	4 (33.3)	18	9 (50)
Surgical	30	19	10 (56,6)	11	11 (100)
Medical	30	15	8 57.3)	15	9 (60)
Pediatric	30	12	11 (91,7)	18	8 (44)
TOTAL	**120**	**58**	**33 (56.9**	**62**	**37 (59.7)**

Table 3. Percentage distribution of isolates from blood and urine samples of patients according to different wards.

	Sample size		**Isolates**								
Hospital ward	**Blood**	**Urine**	***E. coli* (26)** Blood	Urine	***Staphylococcus* spp. (17)** Blood	Urine	***Pseudomonas* spp. (16)** **B**lood	Urine	***Klebsiella* spp. (12)** Blood	Urine	**Total**
ICU	15	15	2(13.3)	4(26.7)	0(0.0)	2(13.3)	1(6.7)	2(13.3)	2(13.30	0(0.0)	13(43.3)
Surgical	15	15	3(20)	3(20)	2(13.30	4(26.7)	3(20)	4(26.7)	2(13.3)	1(6.7)	22(73.3)
Medical	15	15	2(13.3)	5(33.3)	2(13.3)	2(13.3)	0(0.0)	3(20)	2(13.3)	1(6.7)	17(56.6)
Pediatric	15	15	3(20)	4(26.7)	1(6.7)	4(26.7)	2(13.3)	1(6.7)	2(13.3)	2(13.3)	19(63.3)
TOTAL	**60**	**60**	**10(16.6)**	**16(26.7)**	**5(8.3)**	**12(20)**	**6(10)**	**10(16.7)**	**8(13.3)**	**4(6.7)**	**71(59.2)**

Table 4: Antibiogram of *Escherichia coli* isolated from blood and urine samples of patients hospitalised at AE-FUTHAI.

	Susceptible		**Resistant**	
Antibiotics	**Blood (n= 10)**	**Urine (n = 16)**	**Blood (n= 10)**	**Urine (n = 16)**
Amoxicillin	6 (60.0)	8 (50.0)	4 (40.0)	8 (50.0)
Ceftriaxone	10 (100.0)	12 (75.0)	0 (0.0)	2 (12.5)
Ciprofloxacin	8 (80.0)	11 (68.8)	2 (20.0)	5 (31.3)
Gentamicin	3 (30.0)	7 (43.8)	7 (70.0)	9 (67.5)
Tetracycline	3 (30.0)	3 (22.8)	7 (70.0)	13 (81.3)

Table 5: Antibiogram of *Staphylococcus* spp. isolated from blood and urine samples of patients hospitalized at AE-FUTHAI.

	Susceptibility		**Resistance**	
Antibiotics	Blood (n = 5)	Urine (n = 12)	Blood (n = 5)	Urine (n = 12)
Amoxicillin	3 (60.0)	4 (33.3)	2 (40.0)	8 (66.7)
Ceftriaxone	4 (80.0)	10 (85.0)	1 (20.0)	2 (17.0)
Ciprofloxacin	3 (60.0)	8 (66.7)	2 (40.0)	4 (33.3)
Gentamicin	2 (40.0)	6 (50.0)	3 (60.0)	6 (50.0)
Tetracycline	1 (20.0)	4 (33.3)	3 (60.0)	8 (66.7)

Table 6: Antibiogram of *Pseudomonas* spp. isolated from blood and urine samples of patients hospitalized at AE-FUTHAI.

	Susceptible		Resistant	
Antibiotics	Blood (n =6)	Urine (n = 10)	Blood (n =6)	Urine (n = 10)
Amoxicillin	4 (66.6)	6 (60.0)	2 (33.3)	4 (40.0)
Ceftriaxone	4 (55.6)	7 (70.0)	2 (33.3)	3 (30.0)
Ciprofloxacin	5 (83.3)	5 (50.0)	1 (16.7)	5 (50.0)
Gentamicin	2 (33.3)	3 (30.0)	4 (66.6)	7 (70.0)
Tetracycline	2 (33.3)	4 (40.0)	4 (66.6)	6 (60.0)

Table 7: Antibiogram of *Klebsiella* spp. isolated from blood and urine samples of patients hospitalized at AE-FUTHAI.

	Susceptible		Resistant	
Antibiotics	**Blood (n =8)**	**Urine (n = 4)**	**Blood (n =8)**	**Urine (n = 4)**
Amoxicillin	4 (50.0)	3 (75.0)	4 50.0)	1 (25.0)
Ceftriaxone	3(37.5)	2 (50.0)	5 (62.5)	2 (50.0)
Ciprofloxacin	5 (62.5)	2 (50.0)	3 (37.5)	2 (50.0)
Gentamicin	4 (50.0)	1 (25.0)	4 (50.0)	3 (75.0)
Tetracycline	6 (75.0)	3 (75.0)	2 (25.0)	1 (25.0)

Multiple antibiotic resistance index (MARI)

Table 8: Multiple antibiotics susceptibility test of the isolated bacteria species.

Serial Number	Organisms Isolated	MARI (Multiple Antibiotics Resistance Index)
1.	*Staphylococcus* spp.	0.5
2.	*Escherichia coli*	0.6
3.	*Pseudomonas* spp.	0.4
4.	*Klebsiella* spp.	0.7

4. DISCUSSION

This study identified both Gram-negative and Gram-positive bacterial species, including *Escherichia coli*, *Staphylococcus spp.*, *Pseudomonas spp.*, and *Klebsiella spp.* Similarly, Davoudi *et al*. (2012) reported *Staphylococcus aureus*, *coagulase-negative staphylococci (CoNS)*, *Streptococcus pneumoniae*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Acinetobacter*, and *Enterococci* as major bacterial pathogens responsible for nosocomial infections. In this study, 71 (59.2%) pathogenic isolates were recovered from 120 blood and urine samples collected from hospitalized patients at AE-FUTHAI. Among these, 29 isolates (48.3%) were from blood samples, while 42 isolates (70%) were from urine samples. This finding is consistent with Nouri *et al*. (2020), who reported 59.6% prevalence of nosocomial infections in urine samples from hospitalized patients in Iran. *Escherichia coli* was the most predominant pathogen, accounting for 26 isolates (21.7%), followed by *Staphylococcus spp.* with 17 isolates (14.2%), *Pseudomonas spp.* with 16 isolates (13.3%), and *Klebsiella spp.*, which had the lowest prevalence at 12 isolates (10.0%). These findings are consistent with previous studies, where *Staphylococcus spp.* had a prevalence of 15.0% (Yakubu *et al*., 2020), *Pseudomonas spp.* was 13.3% (Hamal *et al*., 2021), and *Klebsiella spp.* was 18.0% (Kaye *et al*., 2024). In contrast, a study in Egypt identified *Klebsiella pneumoniae* as the most frequently isolated nosocomial pathogen (33.5%), followed by *E. coli* (19.3%) (Negm *et al*., 2021).

The high prevalence of *E. coli* in this study may be attributed to endogenous contamination from the bowel, transmission through contaminated hospital objects, and its resistance to common antiseptics (Raj *et al*., 2014). Similar study by Lawani *et al*. (2015) also identified *E. coli* as the leading cause of hospital-acquired infections. These results highlight the burden of bacterial pathogens in nosocomial infections and emphasize the need for strengthened infection control measures and antimicrobial stewardship programs in healthcare settings. Nosocomial infections were detected in 34 male patients (58.6%) and 37 female patients (59.7%), showing a slightly higher prevalence among females. This aligns with previous research by Moti *et al*. (2018), which reported a prevalence of 43.4% in males and 56.6% in females. Similarly, Bale and Mukhtar (2021) found a prevalence of 41.0% in males and 59.0% in females in a study conducted in two hospitals in Kano State, Nigeria. These findings reinforce the significance of nosocomial infections as a major public health challenge, contributing to high morbidity and mortality among hospitalized patients.

The *E. coli* isolates in this study exhibited high susceptibility to ceftriaxone, with resistance ranging from 0.0% to 12.5%. However, they showed relatively high resistance to gentamicin and tetracycline, ranging from 67.5% to 81.3%. This aligns with Negm *et al*.

(2021), who reported that *E. coli* had high resistance to tetracycline, ampicillin, and ceftriaxone. Similarly, *Staphylococcus spp.* demonstrated high susceptibility to ceftriaxone but varied levels of resistance to tetracycline, gentamicin, ciprofloxacin, and amoxicillin. Bale and Mukhtar (2021) reported a moderate level of *S. aureus* resistance to ceftriaxone, while their study found that most Gram-negative isolates exhibited high resistance to amoxicillin and gentamicin.

Furthermore, *Pseudomonas spp.* in this study showed moderate resistance to gentamicin, ceftriaxone, ciprofloxacin, amoxicillin, and tetracycline. *Klebsiella spp.* isolates exhibited high resistance to gentamicin, with moderate resistance to amoxicillin, ciprofloxacin, ceftriaxone, and tetracycline. In contrast, Nouri *et al*. (2020) reported *K. pneumoniae* isolates in Iran with complete (100%) resistance to ciprofloxacin, ceftriaxone, and gentamicin.

Additionally, Unegbu *et al*. (2017) studied antimicrobial resistance patterns in nosocomial infections, reporting moderate resistance levels among both Gram-negative and Gram-positive bacteria, including *S. aureus, S. pneumoniae, E. coli, P. aeruginosa*, *K. pneumoniae*, and *S. pyogenes*. These bacteria exhibited resistance to multiple antibiotics, such as gentamicin, ciprofloxacin, chloramphenicol, tetracycline, ceftriaxone, amoxicillin-clavulanic acid, co-trimoxazole, imipenem, and amikacin. The observed variation in antibiotic resistance patterns highlights the need for effective antibiotic stewardship programs, continuous surveillance, and strict infection control measures to curb the spread of resistant bacterial strains in healthcare settings.

The average MAR index among the bacterial isolates was 0.5. According to previous studies, bacteria with a MAR index above 0.2 potentially possess antibiotic resistance genes (Afunwa *et al*., 2020; Riaz *et al*., 2011). The high resistance patterns observed in this study may be attributed to prior antibiotic usage, inappropriate antibiotic courses, and the severity of infections in patients. Given that the study was conducted in a referral tertiary care hospital, the likelihood of encountering multidrug-resistant organisms is significantly higher.

5. CONCLUSION

The high incidence of antibiotic resistance observed in this study underscores the urgent need for routine surveillance of local resistance patterns. Regular monitoring can guide the selection of the most effective antibiotics for treatment and improve empirical therapy decisions. These findings highlight the growing threat of antibiotic resistance in healthcare settings, particularly in managing hospital-acquired infections. The study emphasizes the necessity of implementing robust infection control measures, continuous antimicrobial resistance surveillance, and effective antibiotic stewardship programs. Such interventions are crucial to reducing the burden of resistant infections, protecting patient health, and optimizing hospital resources.

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