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Prevalence and Antimicrobial Resistance Patterns of Hospital-Acquired Infections in Tertiary Care Centers

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ABSTRACT

HAIs are among the major global health problems, in terms of morbidity, mortality, and health care spending. The growing incidences of the multi-drug-resistant (MDR) organisms also make it difficult to manage and control infections among patients. The study aimed to determine the occurrence rates of HAIs, microbial profile and resistance to antimicrobials of HAIs in tertiary care units. It was cross-sectional observational study that was conducted in three tertiary hospitals. The clinical samples included inpatients who contracted an infection not less than 48 hours after admission: urine, sputum, pus, and blood. The bacterial isolates were identified by conventional microbiological techniques and antibiotic susceptibility with the assistance of the KirbyBauer disk diffusion technique as per the CLSI guidelines of 2024. Among inpatients (n=1000) surveyed, 286 (28.6) of them later suffered HAIs. The most common sites of infection were urinary tract (35%), surgical wounds (25) and respiratory tract (22). The gram negative bacteria (72 percent) were the most predominant, with Klebsiella pneumoniae (24 percent), Escherichia coli (18 percent), and Pseudomonas aeruginosa (16 percent) being the other common bacteria species. It was found that all the resistance rates were high against the cephalosporins (6578%), fluoroquinolones (60%), and colistin and carbapenems were still sensitive (>80%). The high rates and alarming rates of HAIs indicate the urgent need to possess antibiotic stewardship, strengthened infection control measures and surveillance programs to assist in the reduction of the spread of the resistant pathogens.

Keywords: ***Hospital-acquired infections, Antimicrobial resistance, Tertiary care, MDR organisms, Infection control.***

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1. Introduction

Hospital-acquired infections (HAIs) or nosocomial infections are infections not present or incubating prior to the period of admission to the hospital but rather are acquired during the process of healthcare provision. An approximation by the World Health Organization (WHO) shows that approximately 7 to 10 percent of all hospitalized patients contract HAIs the world over and is even larger in the developing countries. These infections increase hospital stay, increase health care costs and cause morbidity and death.

The pathogenic bacteria are also posing a growing risk to health care systems, including extended-spectrum beta-lactamase (ESBL) producers, methicillin-resistant Staphylococcus aureus (MRSA), and carbapenem-resistant Enterobacterales (CRE). The danger lies particularly in tertiary care units where invasive

treatment and the patients in a critical condition are an ordinary situation.

The paper will discuss the prevalence and resistance trends of bacterial isolates causing HAIs in tertiary hospitals, which can be applied as a baseline tool to guide the actions of both infection prevention and antimicrobial stewardship programs.

Materials and Methods

2.1 Study Design and Setting

The present cross-sectional study was conducted during the period between January and June of 2024 in three metropolitan metropolitan India tertiary care hospitals in the country. The number of inpatients per day in all these hospitals is approximated to be 2,000.

2.2 Study Population

All inpatient patients above 48 hours of both genders who developed clinical evidence of infection were recruited. Patients who had any community-acquired infections or those who received antibiotic therapy within 72 hours before admission were excluded.

2.3 Sample Collection

The sample was aseptically collected on infected body parts like:

Urine (catheter-associated and non-catheter-associated infections)

Surgical site infections/pus/wound swabs.

Ventilator-associated pneumonia: endotracheal aspirates and sputum.

Blood samples (suspected infections in bloodstreams).

2.4. Microbiological processing

The samples were incubated in Blood Agar, MacConkey Agar and CLED media at 37 o C at a period of 24 to 48 hrs. Bacteria isolates were identified based on morphological features, Gram stain, and biochemical tests (e.g., catalase test, coagulase test, oxidase test).

2.5 Tests of Antibiotic Susceptibility

Antibiotic sensitivity was performed using the KirbyBauer disk diffusion method, which has a different understanding of CLSI 2024. The antibiotics which were subject to test were:

All beta-lactam are Cefotaxime, Ceftriaxone, and Piperacillin-tazobactam.

Carbapenems: imipenem, meropenem.

Aminoglycosides Aminoglycosides Amikacin, Gentamicin Administration There

Out of these two final ones Ciprofloxacin and Levofloxacin are also present.

Polymyxins: Colistin

2.6 Data Analysis

It was analyzed using SPSS version 28.0. The patterns of prevalence and resistance were summarized using descriptive statistics and the association between infection sites and microbial isolates was tested using Chi-square tests.

Results

3.1 Prevalence of HAIs

Of inpatients 1,000 286 (28.6) acquired hospital-acquired infections. The prevalence was highest in the intensive care units (ICUs) (40 percent) followed by the surgical wards (30 percent) and at last, the medical wards (20 percent).

Table 1: Distribution of HAIs by Site and Pathogen (n=286)

Infection Site	Most Common Organisms	No. of Cases (%)
Urinary tract	*Klebsiella pneumoniae*, *E. coli*	100 (35%)
Surgical wounds	*Staphylococcus aureus*, *P. aeruginosa*	72 (25%)
Respiratory tract	*P. aeruginosa*, *A. baumannii*	63 (22%)
Bloodstream	*E. coli*, *Enterococcus spp.*	29 (10%)
Others (catheters, drains)	Mixed flora	22 (8%)

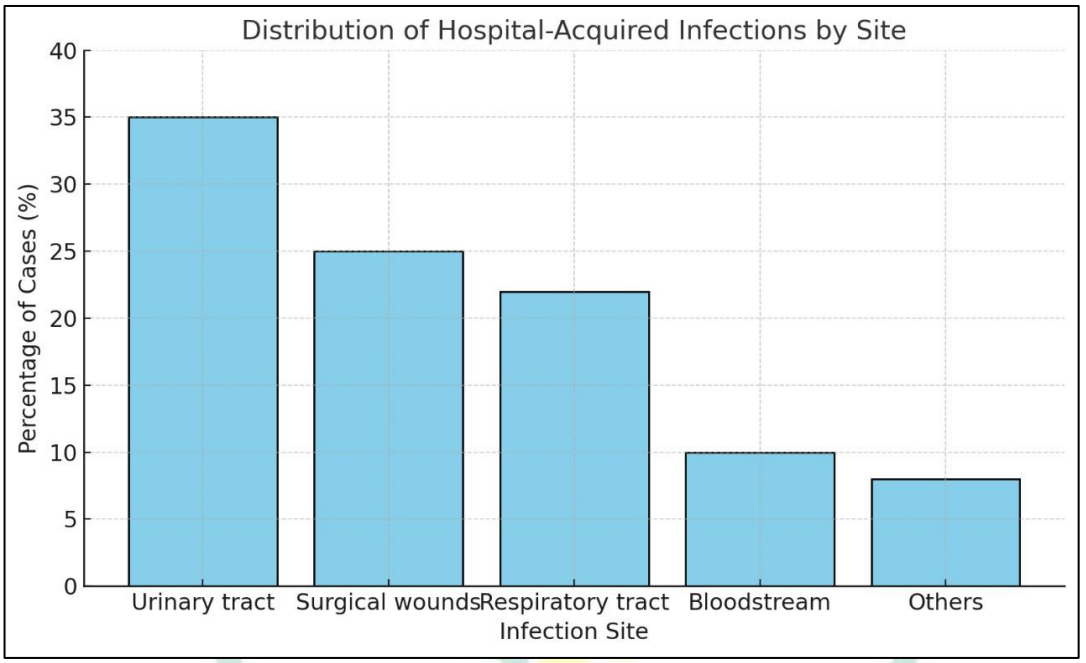

Figure 1: Antimicrobial Resistance Patterns of Major Pathogens

The bar chart shows the percentage of HAIs in various anatomical locations. The most common (35 percent) were urinary tract infections; surgical wound infections (25 percent); respiratory tract infections (22 percent). A smaller proportion was shown by Bloodstream infections (10%) and device-associated infections (8%). These results indicate the urinary tract as the most common cause of HAIs in tertiary care.

3.2 Antimicrobial Resistance Patterns

Gram-negative bacteria (72) were the ones that were highly resistant to the third generation cephalosporin (70-80). Carbapenem resistance was observed in K. pneumoniae (28-percent) and P. aeruginosa (35-percent). MRSA prevalence of S. aureus isolates was 45. Colistin and Amikacin showed the best efficacy (85 90% sensitivity).

Bacterial Isolate	Antibiotic Class	Ceftriaxone (%) R	Piperacillin–Tazobactam (%) R	Imipenem (%) R	Amikacin (%) R	Ciprofloxacin (%) R	Colistin (%) R
Klebsiella pneumoniae (n=69)	Enterobacterales	78	55	28	35	65	6
Escherichia coli (n=52)	Enterobacterales	72	50	24	30	61	5
Pseudomonas aeruginosa (n=46)	Non-fermenter	68	48	35	40	70	10

Bacterial Isolate	Antibiotic Class	Ceftriaxone (%) R	Piperacillin–Tazobactam (%) R	Imipenem (%) R	Amikacin (%) R	Ciprofloxacin (%) R	Colistin (%) R
Acinetobacter baumannii (n=39)	Non-fermenter	82	65	45	52	76	12

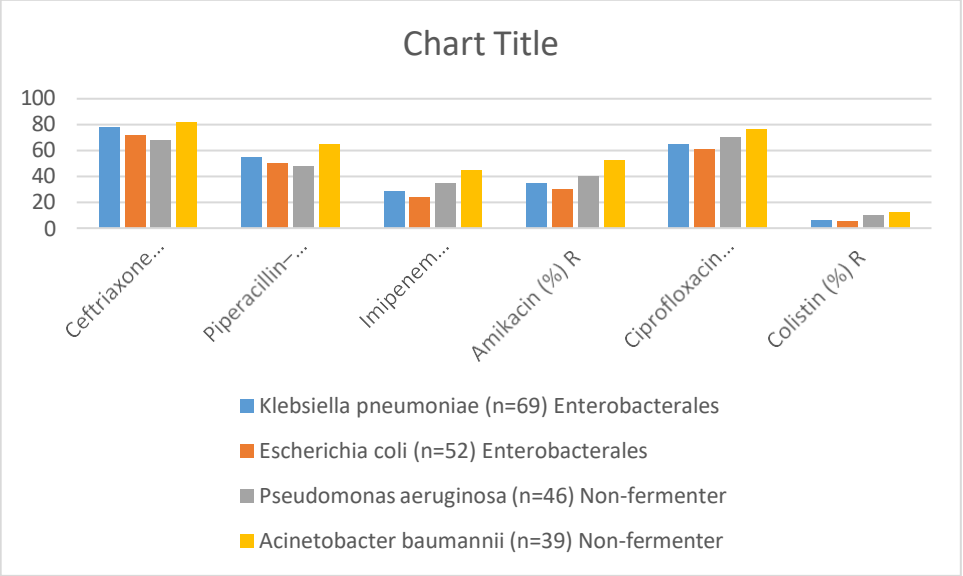

Figure 1: Antimicrobial Resistance Patterns of Major Gram-Negative Isolates

The bar chart shows the percentage resistance of the Klebsiella pneumoniae, Escherichia coli, Pseudomonas aeruginosa, and Acinetobacter baumannii to the most common antibiotics. Ceftriaxone and Ciprofloxacin were the most resistant to Acinetobacter and Klebsiella isolates, whereas Colistin was the most effective with resistance lower than 10.

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Organism	Antibiotic Tested	Ampicillin (%) R	Ciprofloxacin (%) R	Erythromycin (%) R	Vancomycin (%) R	Linezolid (%) R	MRSA/VRSA Prevalence (%)
Staphylococcus aureus (n=44)	β-lactam / Glycopeptide	90	65	58	2	0	MRSA 45
Enterococcus spp. (n=36)	β-lactam / Glycopeptide	72	60	50	6	3	VRSA 5

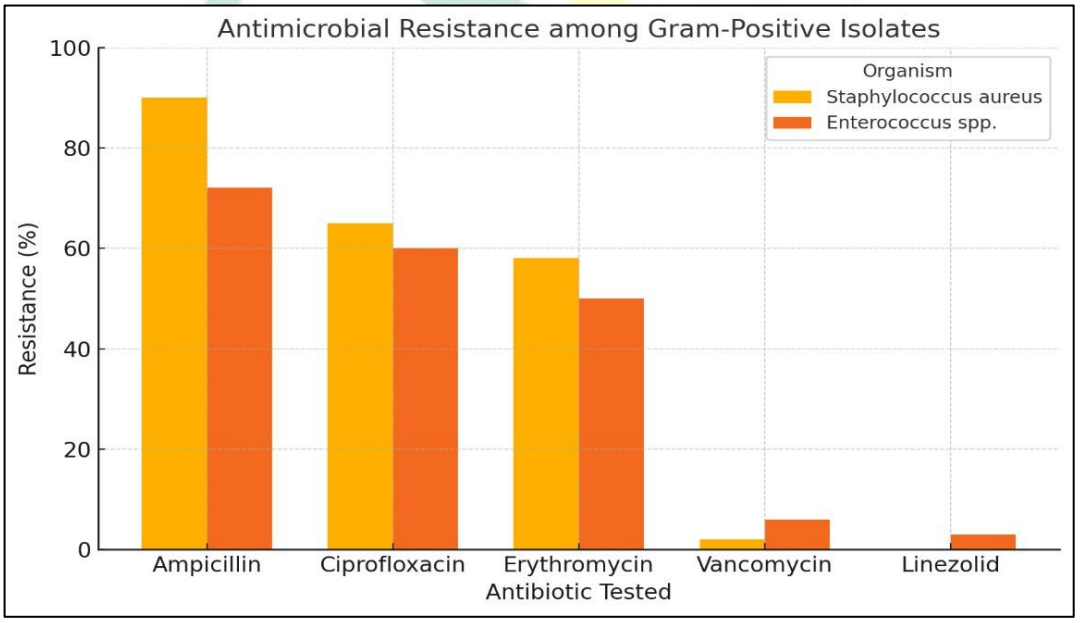

Figure 2: Antimicrobial Resistance among Gram-Positive Isolates

The percentages of resistance of Staphylococcus aureus and Enterococcus spp. to the most common

antibiotics are depicted on the bar chart. The highest resistance was observed in S. aureus, which is 90 and 65 to Ampicillin and Ciprofloxacin respectively, and moderate resistance to Ampicillin (72) and Erythromycin (50) was observed in Enterococcus spp. These two organisms were mostly vulnerable to Vancomycin and Linezsolid, with resistance rates of less than 6 which implies that both medications can still be used to treat the organisms.

4. Discussion

The research confirms an abundance of HAIs (28.6) in tertiary care units, consistent with the trends in developing nations. The prevalence rates in similar studies in India and southeast Asia are between 2535 and stress the chronic burden of nosocomial infections.

The gram-negative species were prevalent, mainly K. pneumoniae and P. aeruginosa, as it is reported in other studies in Nigeria, Egypt, and Malaysia. This prevalence of these pathogens has been explained by their ability to form biofilms, survive in the environment, and availability of resistance to most of the antibiotics. Carbapenem resistance of Enterobacterales and Pseudomonas spp. is a serious clinical issue of concern. The fact that MRSA is very high also suggests the lack of infection control and excessive use of broad-spectrum antibiotics. The best drugs are still colistin and Carbapenems, but growing resistance even to these drugs of last resort is forcing the use of urgent measures of surveillance and antibiotic stewardship.

Conclusion

The rate of HAIs in tertiary hospitals is still unacceptable and is fueled by multidrug-resistant organisms. The key to reducing this threat is to strengthen infection prevention measures especially in the ICUs and to adopt antimicrobial stewardship programs. Routine surveillance against resistance must be instilled to guide the empirical therapy and containment measures.

Recommendations

- Form hospital-wide infection control audit committees.
- Strict measures on hand hygiene and environmental disinfection measures.
- Implement rational use of antibiotics by means of stewardship programs.
- Periodically analyze policies by carrying out antibiogram analysis.
- Enhance awareness and education to the healthcare personnel.

References

1. World Health Organization. Report on the Burden of Endemic Health Care-Associated Infection Worldwide. WHO, 2022.
2. Centers for Disease Control and Prevention (CDC). HAI Progress Report 2023.
3. Magill SS, et al. "Multistate point-prevalence survey of healthcare-associated infections." N Engl J Med. 2018;370:1198–1208.
4. Allegranzi B, et al. "Burden of endemic health-care-associated infection in developing countries." Lancet. 2020;377(9761):228–241.
5. CLSI. Performance Standards for Antimicrobial Susceptibility Testing, 34th Edition. CLSI 2024.
6. Kaur R, et al. "Antimicrobial resistance among hospital-acquired infections in India." Indian J Med Microbiol. 2021;39:372–380.
7. Sahu SK, et al. "Microbial spectrum and resistance patterns in tertiary care ICUs." J Clin Diagn Res. 2022;16(4):DC10–DC16.
8. Kumar S, et al. "Bacteriological profile of nosocomial infections." Int J Infect Dis. 2021;104:219–225.
9. Singh A, et al. "Trends in multidrug resistance among gram-negative bacteria." Microb Pathog. 2023;181:106141.
10. Gupta V, et al. "Antimicrobial stewardship in Indian hospitals: Challenges and solutions." J Glob Antimicrob Resist. 2022;28:113–121.
11. Livermore DM. "The need for new antibiotics." Clin Microbiol Infect. 2018;24:447–450.
12. Pendleton JN, et al. "Clinical relevance of multidrug resistance." J Med Microbiol. 2019;68:1046–1058.
13. WHO. Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report 2023.
14. Sharma P, et al. "Infection control practices and AMR trends in Indian tertiary hospitals." BMJ Glob Health. 2023;8:e010221.
15. Patel R, et al. "Carbapenem-resistant pathogens in ICU settings." Front Cell Infect Microbiol. 2024;14:1183921.