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PREVALENCE OF MULTIDRUG-RESISTANT ORGANISMS IN HOSPITAL-ACQUIRED PNEUMONIA AMONG ICU PATIENTS AND ITS CLINICAL OUTCOMES: A PROSPECTIVE OBSERVATIONAL STUDY.

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Abstract

Background

Multidrug-resistant organisms (MDROs) are a growing concern in hospital-acquired pneumonia (HAP) among ICU patients, contributing to increased morbidity, mortality, and healthcare costs. This study aims to evaluate the prevalence, resistance profiles, clinical outcomes, and impact of antibiotic therapy on ICU patients with MDRO-related HAP.

Methods

A total of 100 ICU patients diagnosed with HAP were included in the study. The prevalence of MDROs, resistance profiles of the organisms, and clinical outcomes were assessed. Data on mechanical ventilation, ICU stay duration, mortality rates, and antibiotic therapy were collected and analyzed. The study also examined co-infections and complications in patients with MDRO infections.

Results

100 ICU patients were included, with a mean age of 58.4 ± 12.3 years; 60% were male and 40% were female. The majority of patients had comorbidities such as diabetes mellitus (45%), chronic obstructive pulmonary disease (33%), and hypertension (30%). The most common MDROs identified were *Klebsiella pneumoniae* (24%), *Pseudomonas aeruginosa* (21%), and *Acinetobacter baumannii* (19%). These organisms exhibited high resistance to third-generation cephalosporins, carbapenems, and fluoroquinolones. Patients with MDRO infections had significantly higher rates of mechanical ventilation (69% vs. 28%), prolonged ICU stays (62% vs. 14%), and a higher mortality rate (35% vs. 12%) compared to non-MDRO patients. Appropriate antibiotic therapy improved clinical outcomes, with a 40% improvement rate in the proper therapy group. Co-infections, including *Candida albicans* (12%) and *Staphylococcus aureus* (10%), were common in MDRO-infected patients.

Conclusion

MDROs significantly impact the clinical outcomes of ICU patients with HAP, leading to increased mechanical ventilation, longer ICU stays, and higher mortality. Appropriate antibiotic therapy plays a critical role in improving patient outcomes.

Recommendations

Early MDRO detection in ICU-HAP patients requires surveillance, rapid diagnostics, strict infection control, and antimicrobial stewardship to prevent resistance.

Keywords: *Multidrug-resistant organisms, hospital-acquired pneumonia, Intensive Care Unit, clinical outcomes, antibiotic therapy, co-infections, resistance profiles.*
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Introduction

Hospital-acquired pneumonia (HAP) is a common and serious infection among critically ill patients, especially those in intensive care units (ICUs). It is associated with high morbidity, extended hospital stays, and elevated mortality rates, making it a significant concern in healthcare settings. The emergence of multidrug-resistant organisms (MDROs) in HAP has further complicated treatment strategies, as these pathogens exhibit resistance to multiple classes of antibiotics, resulting in increased

treatment failures, prolonged hospitalization, and poor clinical outcomes [1, 2].

MDROs, such as *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii*, are frequently implicated in HAP. These organisms are particularly problematic in ICU settings due to their ability to persist in the hospital environment, their resistance to commonly used antibiotics, and their association with adverse outcomes like increased mortality, prolonged mechanical ventilation, and extended ICU stays. Over time, the resistance profiles of these organisms have evolved, further limiting the effectiveness of available antibiotics and complicating management strategies for infected patients [3, 4, 5, 6].

The prevalence and impact of MDROs in ICU patients have been well-documented in various studies. For instance, one study found that the prevalence of MDROs in ventilator-associated pneumonia (VAP) was a major concern, with resistance to antibiotics like carbapenems contributing to poor clinical outcomes [1]. Other studies have highlighted the increased incidence of MDRO infections in healthcare-associated pneumonia (HCAP) cases, further emphasizing the challenges in treating critically ill patients [7]. These trends underscore the urgent need for strategies to address the rising threat of MDROs in hospital settings, as their presence significantly impacts patient outcomes and treatment efficacy.

This study aims to assess the prevalence of MDROs in ICU patients with HAP, evaluate their resistance profiles, and examine the clinical outcomes associated with these infections. Additionally, the study investigates the impact of appropriate versus inappropriate antibiotic therapy on patient outcomes.

Methodology

Study Design and Setting

This was a prospective observational study conducted in the Intensive Care Unit (ICU) of Government Medical College, Srikakulam, Andhra Pradesh, India, from January 2024 to December 2024. Government Medical College is a tertiary care teaching institution that serves as a major referral center for the surrounding regions. The ICU is equipped with critical care infrastructure and manages patients with severe and complex medical conditions. This setting provided a robust environment to assess the prevalence, resistance patterns, and clinical outcomes of multidrug-resistant organisms (MDROs) in patients diagnosed with hospital-acquired pneumonia (HAP).

Study Population

The study included all adult ICU patients diagnosed with HAP during the study period. A total of 100 patients were selected based on inclusion and exclusion criteria. Inclusion criteria included patients aged 18 years and above, diagnosed with HAP as per the clinical and radiological criteria, and those who had been in the ICU for at least 48 hours before the onset of pneumonia. Exclusion criteria included patients with pneumonia present at the time of ICU admission, those with immunocompromised states (e.g., undergoing chemotherapy, HIV positive), and patients who had been previously treated with antibiotics for a prolonged period before ICU admission.

Data Collection

Data were collected using a structured case report form, which included demographic details (age, sex), comorbidities (diabetes mellitus, hypertension, chronic obstructive pulmonary disease), and clinical parameters such as duration of ICU stay, mechanical ventilation requirements, antibiotic therapy received, and clinical outcomes (e.g., mortality, discharge).

Microbiological data were obtained from respiratory samples (e.g., sputum, tracheal aspirates, bronchoalveolar lavage) collected from patients with suspected HAP. These samples were cultured and identified for bacterial organisms. The isolates were tested for antibiotic susceptibility using standard laboratory techniques (e.g., disk diffusion method, automated systems, and E-test). Resistance patterns to commonly used antibiotics, including third-generation cephalosporins, carbapenems, fluoroquinolones, and aminoglycosides, were recorded.

Clinical Outcomes

The primary clinical outcomes evaluated included the need for mechanical ventilation, the duration of ICU stay, and the mortality rate. Secondary outcomes included the improvement in clinical condition based on antibiotic therapy (appropriate or inappropriate), the presence of co-infections, and complications during hospitalization.

Antibiotic Therapy

Patients received either appropriate or inappropriate antibiotic therapy based on the susceptibility profile of the identified organisms. Appropriate therapy was defined as the use of antibiotics to which the isolated organism was sensitive, while inappropriate therapy was defined as the use of antibiotics that were ineffective against the identified pathogens. The outcomes of patients receiving appropriate versus inappropriate therapy were compared to assess the impact of timely and targeted treatment on patient recovery.

Statistical Analysis

Data were analyzed using descriptive and inferential statistical methods. Continuous variables such as age and duration of ICU stay were presented as mean ± standard deviation (SD). Categorical variables such as gender, comorbidities, and clinical outcomes were expressed as percentages. The chi-square test was used to compare categorical

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variables, and the t-test was used for continuous variables between groups. A p-value of <0.05 was considered statistically significant.

Bias

To minimize potential sources of bias in this prospective observational study, several steps were taken. A standardized case report form was used for uniform data collection across all participants. Inclusion and exclusion criteria were strictly applied to reduce selection bias, and only patients who developed HAP after 48 hours of ICU admission were included to ensure accurate classification. Microbiological analyses and antibiotic sensitivity testing were conducted using validated laboratory protocols to avoid diagnostic misclassification. Furthermore, outcome assessments, including ICU stay duration and mechanical ventilation status, were based on **objective clinical records**, limiting observer bias. Data entry and analysis were independently cross-verified by multiple investigators to reduce reporting and analytical bias.

Ethical Considerations

The study was approved by the Institutional Ethics Committee, Government Medical College, Srikakulam, and written informed consent was obtained from all participants or their legal guardians.

Results

In this study, we analyzed the incidence and clinical outcomes of multidrug-resistant organisms (MDROs) in hospital-acquired pneumonia (HAP) among ICU patients. 100 ICU patients were included in the study, with a mean age of 58.4 ± 12.3 years. The male-to-female ratio was 60:40, and the majority of patients had underlying conditions such as diabetes mellitus (45%), chronic obstructive pulmonary disease (COPD) (33%), and hypertension (30%) (Table 1).

Table 1: Patient Demographics

Parameter	Value
Total Patients	100
Mean Age (Years)	58.4 ± 12.3
Male to Female Ratio	60:40
Diabetes Mellitus	45%
Chronic Obstructive Pulmonary Disease (COPD)	33%
Hypertension	30%

The incidence of MDROs in the study population was as follows: *Klebsiella pneumoniae* (24%), *Pseudomonas aeruginosa* (21%), *Acinetobacter baumannii* (19%), *Escherichia coli* (8%), and *Enterococcus faecium* (7%) (Table 2). These organisms were predominantly responsible for the infections in ICU patients with HAP.

Table 2: Prevalence of MDROs

Organism	Percentage of Total Infections
Klebsiella pneumoniae	24%
Pseudomonas aeruginosa	21%
Acinetobacter baumannii	19%
Escherichia coli	8%
Enterococcus faecium	7%

Table 3 presents the resistance profiles of the MDROs. *Klebsiella pneumoniae* exhibited significant resistance to third-generation cephalosporins (75%) and carbapenems (40%). *Pseudomonas aeruginosa* showed high resistance to fluoroquinolones (55%) and aminoglycosides (60%). *Acinetobacter baumannii* demonstrated resistance to carbapenems (70%) and beta-lactams (70%).

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Table 3: Resistance Profile of MDROs

Organism	Resistance to Third-Generation Cephalosporins (%)	Resistance to Carbapenems (%)	Resistance to Beta-lactams (%)	Resistance to Fluoroquinolones (%)	Resistance to Aminoglycosides (%)
Klebsiella pneumoniae	75%	40%	-	-	-
Pseudomonas aeruginosa	-	-	60%	55%	-
Acinetobacter baumannii	-	-	70%	-	70%

Clinical outcomes of patients with MDRO infections were compared to those without MDRO infections. Patients infected with MDROs had significantly higher rates of mechanical ventilation (69%) compared to those without MDRO infections (28%). Additionally, the duration of ICU stay was prolonged for MDRO-infected patients, with 62% experiencing a prolonged stay versus 14% in the non-MDRO group (Table 4).

Table 4: Clinical Outcomes

Parameter	Patients with MDRO Infection	Patients without MDRO Infection
Mechanical Ventilation (%)	69%	28%
Prolonged ICU Stay (%)	62%	14%
Mortality Rate (%)	35%	12%

The mortality rate was significantly higher in patients with MDRO infections (35%) compared to those without MDRO infections (12%).

Table 5 illustrates the impact of antibiotic therapy on clinical outcomes. Among the 63 patients who received appropriate therapy, 40% showed improved clinical outcomes, whereas 35 patients who received inappropriate therapy had a 32% treatment failure rate. These findings underscore the importance of appropriate antibiotic selection in improving patient outcomes.

Table 5: Impact of Antibiotic Therapy

Therapy Type	Number of Patients	Improved Clinical Outcomes (%)	Treatment Failure (%)
Appropriate Therapy	63	40%	
Inappropriate Therapy	35		32%

Finally, Table 6 presents the complications and co-infections in MDRO-infected patients. *Candida albicans* and *Staphylococcus aureus* were the most common co-infections, affecting 12% and 10% of MDRO-infected patients, respectively.

Table 6: Complications and Co-Infections

Co-Infection	Percentage of MDRO Patients (%)
Candida albicans	12%
Staphylococcus aureus	10%

Discussion

The results of this study underscore the significant impact of multidrug-resistant organisms (MDROs) on the clinical outcomes of ICU patients with hospital-acquired pneumonia (HAP). Study findings show that the prevalence of MDRO infections is alarmingly high, with *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii* being the most common pathogens identified. The high resistance of these organisms to commonly used antibiotics presents a significant challenge in the treatment of HAP, leading to prolonged ICU stays, increased mechanical ventilation requirements, and higher mortality rates. This aligns with previous research, which has highlighted the severe impact of MDROs on ICU patients and emphasizes the urgent need for effective management strategies for these infections [8].

This study's findings corroborate prior studies that have demonstrated the substantial burden of MDROs in ICU settings. Specifically, patients with MDRO-related HAP exhibited significantly higher rates of mechanical ventilation and extended ICU stays, which have been consistently observed in other studies [9]. These findings emphasize the critical role of early and appropriate antibiotic therapy in improving patient outcomes. In our study, patients who received appropriate antibiotic therapy had a 40% improvement rate in clinical outcomes, a result consistent with existing literature that suggests timely, targeted treatment is essential in managing MDRO infections effectively [10]. In contrast, patients receiving inappropriate therapy had a higher treatment failure rate, reinforcing the importance of selecting antibiotics based on susceptibility testing [11].

One of the most concerning findings in our study was the elevated mortality rate among MDRO-infected patients (35%) compared to those without MDRO infections (12%). This highlights the lethal nature of MDRO-related HAP in critically ill patients, as these infections are difficult to treat and often associated with poor prognoses. The prolonged ICU stay and the need for mechanical ventilation observed in MDRO-infected patients may be indicative of the severity of the infections and the challenges in achieving clinical improvement. This finding is in line with similar studies that have documented the poor outcomes associated with MDRO infections in ICU patients [12].

Co-infections and complications also played a significant role in the clinical outcomes of patients with MDRO infections. *Candida albicans* and *Staphylococcus aureus* were the most common co-infections, affecting a significant proportion of MDRO-infected patients. The presence of co-infections complicates the management of HAP, making it even more difficult to achieve positive outcomes. Critically ill patients are often at increased risk for secondary infections, which can further exacerbate their condition [13].

The resistance profiles of the organisms isolated in this study were consistent with previous reports. *Klebsiella pneumoniae* exhibited high resistance to third-generation cephalosporins and carbapenems, while *Pseudomonas aeruginosa* showed resistance to fluoroquinolones and aminoglycosides. *Acinetobacter baumannii* demonstrated significant resistance to both carbapenems and beta-lactams. These resistance patterns are in line with previous studies that highlight the limitations of current antibiotic therapies and underscore the need for alternative treatment strategies, including the use of newer antibiotics or combination therapies [14].

The findings of this study have important implications for clinical practice. Early identification of MDRO infections and the implementation of appropriate antibiotic therapy are critical in improving patient outcomes. Moreover, the high incidence of MDROs in HAP underscores the need for ongoing surveillance and antimicrobial stewardship programs to monitor resistance trends and guide appropriate treatment. Additionally, infection control measures, including strict hygiene protocols and isolation precautions, are essential in preventing the spread of resistant organisms within ICU settings.

Generalizability

The findings are generalizable to similar tertiary care ICUs in resource-limited settings; however, differences in patient populations, microbial ecology, and antibiotic practices may limit broader applicability.

Conclusion

Multidrug-resistant organisms pose a significant threat to ICU patients with hospital-acquired pneumonia, leading to increased morbidity, prolonged ICU stays, and higher mortality rates. The findings of this study highlight the importance of early identification, appropriate antibiotic therapy, and effective infection control measures in managing MDRO-related infections. Further research is needed to explore alternative treatment options and to develop strategies to prevent the emergence and spread of MDROs in hospital settings.

Limitations

Limitations of the study include its retrospective design, which may introduce bias in data collection, and the relatively small sample size of 100 patients, limiting the generalizability of the findings. Additionally, the study did not assess the long-term outcomes or potential influence of other variables, such as underlying comorbidities.

Recommendations

Based on the findings, early detection of MDROs in ICU patients with HAP should be prioritized through routine surveillance and rapid diagnostic testing. Strict infection control measures and antimicrobial stewardship programs are essential to prevent the spread of resistant organisms. Tailored antibiotic therapy based on sensitivity patterns must be initiated promptly to improve clinical outcomes.

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List of Abbreviations

HAP – Hospital-Acquired Pneumonia
ICU – Intensive Care Unit

MDRO – Multidrug-Resistant Organism
COPD – Chronic Obstructive Pulmonary Disease
VAP – Ventilator-Associated Pneumonia
HCAP – Healthcare-Associated Pneumonia

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Data Available

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References
1. Hammoudi Halat D, Ayoub Moubareck C. Hospital-acquired and ventilator-associated pneumonia caused by multidrug-resistant Gram-negative pathogens: Understanding epidemiology, resistance patterns, and implications with COVID-19. F1000Res. 2024 Mar 25;12:92. doi: 10.12688/f1000research.129080.1. PMID: 38915769; PMCID: PMC11195619. https://doi.org/10.12688/f1000research.129080.1
2. Vallés J, Martin-Loeches I, Torres A, Diaz E, Seijas I, López MJ, et al. Antibiotic therapy and clinical outcomes of healthcare-associated pneumonia in critically ill patients: a Spanish cohort study. Intensive Care Med. 2014 Apr;40(4):572-81. doi: 10.1007/s00134-014-3239-2. Epub 2014 Mar 18. PMID: 24638939; PMCID: PMC7094988. https://doi.org/10.1007/s00134-014-3239-2
3. Choudhuri AH, Ahuja B, Biswas PS, Uppal R. Epidemiology of Multidrug-Resistant Infections after Inter-ICU Transfer in India. Indian J Crit Care Med. 2019 Jan;23(1):1-6. doi: 10.5005/jp-journals-10071-23103. PMID: 31065200; PMCID: PMC6481264. https://doi.org/10.5005/jp-journals-10071-23103
4. Patil HV, Patil VC. Incidence, bacteriology, and clinical outcome of ventilator-associated pneumonia at a tertiary care hospital. J Nat Sci Biol Med. 2017 Jan-Jun;8(1):46-55. doi: 10.4103/0976 9668.198360. PMID: 28250674; PMCID: PMC5320823. https://doi.org/10.4103/0976-9668.198360
5. Jung JY, Park MS, Kim YS, Park BH, Kim SK, Chang J, Kang YA. Healthcare-associated pneumonia among hospitalized patients in a Korean tertiary hospital. BMC Infect Dis. 2011 Mar 11;11:61. Doi: 10.1186/1471-2334-11-61. PMID: 21396096; PMCID: PMC3063837. https://doi.org/10.1186/1471-2334-11-61
6. Solmaz İ, Kalın BS. Assessment of antibiotic resistance of infectious agents in patients with pneumonia in the tertiary critical care unit and its effect on clinical outcomes. Int J Clin Pract. 2021 Apr;75(4):e13872. doi: 10.1111/ijcp.13872. Epub 2020 Dec 18. PMID: 33247984. https://doi.org/10.1111/ijcp.13872
7. Bhadade R, Harde M, deSouza R, More A, Bharmal R. Emerging trends of nosocomial pneumonia in the intensive care unit of a tertiary care public teaching

hospital in Western India. Ann Afr Med. 2017 Jul-Sep;16(3):107-113. doi: 10.4103/aam.aam_7_17. PMID: 28671150; PMCID: PMC5579893. https://doi.org/10.4103/aam.aam_7_17

8. Chang Y, Jeon K, Lee SM, Cho YJ, Kim YS, Chong YP, Hong SB. The Distribution of Multidrug-resistant Microorganisms and Treatment Status of Hospital-acquired Pneumonia/Ventilator-associated Pneumonia in Adult Intensive Care Units: a Prospective Cohort Observational Study. J Korean Med Sci. 2021 Oct 25;36(41):e251. Doi: 10.3346/jkms.2021.36.e251. PMID: 34697926; PMCID: PMC8546312. https://doi.org/10.3346/jkms.2021.36.e251
9. Dey A, Bairy I. Incidence of multidrug-resistant organisms causing ventilator-associated pneumonia in a tertiary care hospital: a nine-month prospective study. Ann Thorac Med. 2007 Apr;2(2):52-7. doi: 10.4103/1817-1737.32230. PMID: 19727346; PMCID: PMC2732076. https://doi.org/10.4103/1817-1737.32230
10. Oliveira ABS, Sacillotto GH, Neves MFB, Silva AHND, Moimaz TA, Gandolfi JV, Nogueira MCL, Lobo SM. Prevalence, outcomes, and predictors of multidrug-resistant nosocomial lower respiratory tract infections among patients in an ICU. J Bras Pneumol. 2023 Jan 23;49(1):e20220235. Doi: 10.36416/1806-3756/e20220235. PMID: 36700572; PMCID: PMC9970364. https://doi.org/10.36416/1806-3756/e20220235
11. Lee H, Park JY, Lee T, Lee YJ, Lim HJ, Park JS, Yoon HI, Lee JH, Lee CT, Cho YJ. Intermediate risk of multidrug-resistant organisms in patients who were admitted to the intensive care unit with healthcare-associated pneumonia. Korean J Intern Med. 2016 May;31(3):525-34. doi: 10.3904/kjim.2015.103. Epub 2016 Mar 11. PMID: 26968189; PMCID: PMC4855101. https://doi.org/10.3904/kjim.2015.103
12. Mantri T, Burad J, Hashmi SA, Jaadi SSAA, Aladawi B, Balushi WAS. A Retrospective Closed Cohort Study on Distribution of Multidrug-Resistant Bacteria in Ventilator-Associated Pneumonia and Its Impact on Patient Outcome. J Intensive Care Med. 2024 Oct 24:8850666241290468. Doi: 10.1177/08850666241290468. Epub ahead of print. PMID: 39444321. https://doi.org/10.1177/08850666241290468
13. Martin-Loeches I, Torres A, Rinaudo M, Terraneo S, de Rosa F, Ramirez P, Diaz E, Fernández-Barat L, Li Bassi GL, Ferrer M. Resistance patterns and outcomes in intensive care unit (ICU)-acquired pneumonia. Validation of the European Centre for Disease Prevention and Control (ECDC) and the Centers for Disease Control and Prevention (CDC) classification of multidrug-resistant organisms. J Infect. 2015 Mar;70(3):213-22. doi: 10.1016/j.jinf.2014.10.004. Epub 2014 Oct 27. PMID: 25445887. https://doi.org/10.1016/j.jinf.2014.10.004
14. Al-Sunaidar KA, Aziz NA, Hassan Y, Jamshed S, Sekar M. Association of Multidrug Resistance Bacteria and Clinical Outcomes of Adult Patients with Sepsis in the Intensive Care Unit. Trop Med Infect Dis. 2022 Nov 9;7(11):365. doi: 10.3390/tropicalmed7110365. PMID: 36355907; PMCID: PMC9692934. https://doi.org/10.3390/tropicalmed7110365

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