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Case Report

Antibiotic Profile of *K. Pneumoniae* Isolated from Endotracheal Aspirate in a Tertiary Care Hospital

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ABSTRACT:
Background & Aim: To identify local trends in antibiotic resistance, this study looks at the antibiotic resistance profile of *K. pneumoniae* isolates from endotracheal aspirates. **Materials & methods:** 7-month observational research at Hi-Tech Medical College & Hospital, Rourkela, involved 196 samples from ICU patients suspected of ventilator-associated pneumonia. Out of these, 132 were positive. The majority (46.96%) were K. pneumoniae, with a female and male gender distribution. Samples were processed using standard techniques. Identification was done using biochemical assays and automated techniques. Antibiotic susceptibility testing was performed using Kirby-Bauer disk diffusion and VITEK-2. The study examined various antibiotics, including beta-lactams, aminoglycosides, and fluoroquinolones. **Results:** Out of the 196 tested endotracheal aspirate samples, 132 (48%) were positive for K. pneumoniae, constituting about 62 (46.96%) of the total. Other organisms comprised 41 (31.06%), and others comprised 29 (21.96%). Most patients were male (58.06%), with an average age of 55 years. Patients with prolonged ICU stays (>10 days) accounted for most isolates. 10 (16.39%) were sensitive to gentamicin (n=61), and 12 (19.3%) were sensitive to amikacin (n=62). **Conclusion:** According to the study, *K. pneumoniae* in endotracheal aspirates from intensive care unit patients is growing more resistant to antibiotics. This suggests that urgent action is required, including prudent antibiotic usage, strong infection control, and ongoing resistance monitoring.

Keywords: *K. pneumoniae*, *Acinetobacter baumannii*, ventilator-associated pneumonia, endotracheal aspiration, antibiotic susceptibility testing, Clinical and Laboratory Standards Institute criteria.

Introduction:

Hospital-acquired illnesses such as pneumonia, UTIs, septicemia, and wound infections are caused by the facultative anaerobic, Gram-negative bacteria Klebsiella pneumoniae (*K. pneumoniae*) [1–3]. Because multidrug-resistant (MDR) *K. pneumoniae* is becoming more common, it is especially troublesome in critical care units (ICUs) [4-6]. A useful diagnostic technique for identifying the microorganisms causing an infection and figuring out which medications work best against it is the endotracheal aspirate (ETA) culture [1-4].

With the rise of ESBL-producing and carbapenem-resistant *K. pneumoniae* (CRKP) strains, antibiotic resistance in *K. pneumoniae* has escalated [7-9]. These resistant strains raise morbidity, mortality, and healthcare costs while decreasing available treatments [10]. Antimicrobial stewardship initiatives are necessary because hospital antibiotic abuse and overuse have facilitated the evolution of these resistant bacteria.

Enzymes that break down β-lactam antibiotics, efflux pumps that remove antibiotics from bacterial cells, modifications to outer membrane proteins that limit antibiotic penetration into bacterial cells, and plasmid-mediated resistance and horizontal gene transfer that enable resistance genes to spread quickly throughout bacterial populations are some of the resistance mechanisms in *K. pneumoniae* [4]. Monitoring the antibiotic susceptibility profile of MDR *K. pneumoniae* is essential as the number of ICU patients with this infection rises in order to guarantee successful treatment and avoid failure [5,6]. In order to provide important insights into antibiotic resistance and develop targeted antimicrobial strategies for efficient infection management and better patient outcomes, this project will investigate antibiotic-resistant *K. pneumoniae* isolates from ETA samples at a tertiary care hospital. Since the frequency of MDR and XDR *K. pneumoniae* is increasing at an alarming pace, a continuing investigation of the antibiotic susceptibility profile of *K.*

pneumoniae is necessary. In order to identify local trends in antibiotic resistance, this study looks at the antibiotic resistance profile of *K. pneumoniae* isolates from endotracheal aspirates.

Materials & Methods:

A tertiary care hospital's microbiology department conducted 7-month observational research between July 2024 to January 2025 with 196 samples in total in the Department of Microbiology at Hi-Tech Medical College & Hospital, Rourkela. There are 132 positive samples out of 196 total. ICU patients with a clinical suspicion of ventilator-associated pneumonia (VAP) who had endotracheal aspiration for microbiological testing were included in the research. About 62 (46.96%) of the isolates are *K. pneumoniae*, 41 (31.06%) are Acinetobacter baumannii, and 29 (21.96%) are other species. The gender distribution of *K. pneumoniae* (n=62) patients was 26 (41.93%) female and 36 (58.06%) males.

Gathering and processing samples. Patients who were intubated cleanly with a sterile suction catheter had endotracheal aspirates obtained in an aseptic procedure. After that, the samples were delivered directly to the microbiological lab. The materials were processed using standard microbiological techniques, including chromogenic medium, MacConkey agar, blood agar growth, and Gram staining.

The identification *K. pneumoniae* was done by using different biochemical assays, such as urease, citrate utilization, and indole tests, as well as automated techniques like VITEK-2. When necessary, molecular methods were used to confirm the isolates. Antibiotic susceptibility testing (AST) was done using the Kirby-Bauer disk diffusion technique and VITEK-2, which complies with Clinical and Laboratory Standards Institute (CLSI, M100, 35th Edition) guidelines, was used to assess the isolates' antibiotic susceptibility profile. The following antibiotics were examined. Penicillins, cephalosporins, and carbapenems are examples of beta-lactam antibiotics. Amikacin and Gentamicin are examples of aminoglycosides. Ciprofloxacin and Levofloxacin are examples of fluoroquinolones.

Finding the mechanisms of resistance: To check for ESBL development, ceftazidime and ceftazidime clavulanic acid were used by Kirby-Bauer disk diffusion method in Mueller Hinton agar.

Statistical Analysis:

Data was analyzed using SPSS software. The frequency of resistant isolates was calculated.

Results:

132 (48%) of the 196 endotracheal aspirate samples that were analyzed tested positive for *K. pneumoniae*, which made up around 62 (46.96%), Acinetobacter baumannii, which made up 41 (31.06%), and other organisms, which made up 29 (21.96%). The majority of patients (58.06%) were men, and their average age was 55. The majority of isolates came from patients who spent more than ten days in the intensive care unit.

Antibiotic Susceptibility Pattern

Carbapenem-resistant *K. pneumoniae* (CRKP) was indicated by the following: 3 (5.35%) were susceptible to cefepime (n=56), 3 (5.6%) to ceftriaxone (n=53), 4 (8.5%) to cefuroxime (n=47), 5 (8.1%) to meropenem (n=61), and 2 (3.2%) to imipenem (n=61). Ten (16.39%) were sensitive to gentamycin (n=61), twelve (19.3%) were sensitive to amikacin (n=62), two (3.9%) were sensitive to ciprofloxacin (n=51), two (3.2%) were sensitive to levofloxacin (n=61), two (6.06%) were sensitive to amoxycillin clavulanic acid (n=33), zero (0%) were sensitive to ampicillin (n=53), one (2.32%) was sensitive to ampicillin sulbactam (n=43), seven (11.8%) were sensitive to cotrimoxazole (n=59), and four (6.5%) were sensitive to piperacillin-tazobactam (n=61).

Table 1: The sensitivity pattern of the antibiotics tested against the pathogens

Antibiotic	Sensitive (n)	Total Tested (N)	Sensitivity (%)
Amikacin	12	62	19.35%
Gentamycin	10	61	16.39%
Cotrimoxazole	7	59	11.86%
Cefuroxime	4	47	8.51%
Meropenem	5	61	8.20%
Piperacillin Tazobactam	4	61	6.56%
Amoxycillin Clavulanic Acid	2	33	6.06%
Ceftriaxone	3	53	5.66%
Cefepime	3	56	5.35%

Ciprofloxacin	2	51	3.92%
Levofloxacin	2	61	3.28%
Imipenem	2	61	3.28%
Ampicillin Sulbactam	1	43	2.32%
Ampicillin	0	53	0.00%

Discussion:

In accordance with worldwide results, 196 endotracheal aspirate samples were analyzed, yielding 132 (48%) positive cultures, of which 62 (46.96%) were *K. pneumoniae*, 41 (31.06%) were Acinetobacter baumannii, and 29 (21.96%) were other organisms. Especially in patients on ventilators, these bacteria play a major role in hospital-acquired illnesses.

One significant cause of VAP is *K. pneumoniae*. Around the world, its occurrence in endotracheal aspirates varies. Research conducted in a tertiary hospital in Nepal, for example, found that *K. pneumoniae* was present in 16% of VAP patients, behind Acinetobacter baumannii (56%) and Pseudomonas aeruginosa (24%). *K. pneumoniae's* high frequency in your data highlights how often it is in critically sick individuals' respiratory infections [11-14].

The demographic characteristics of intensive care unit patients worldwide have been the subject of much investigation. The frequency of male patients in intensive care units is an important finding. A study of 24,341 intensive care unit patients, for instance, found that 61.7% of the patients were male, suggesting a significant male majority in critical care settings [14]. Similarly, 63.2% of 853 mechanically ventilated patients in a Chinese multicenter retrospective review were male [15]. The greater incidence of cardiovascular disease and injuries among men, which commonly require urgent treatment, maybe the cause of this male preponderance. Another significant factor in ICU admissions is age. Because various studies have diverse patient demographics and healthcare settings, the average age of ICU patients varies. For instance, the median age of 9,017 intensive care unit patients was 61 years, with women at 61 and males at 59 [16]. According to these results, middle-aged and older patients are more likely to be admitted to intensive care units (ICUs). This is probably because comorbidities and acute medical emergencies are more prevalent in these age groups. Extended intensive care unit (ICU) stays (>10 days) are often associated with increased morbidity and resource consumption. Prolonged hospitalization is often linked to factors including the severity of the disease, the presence of concurrent conditions, and problems during ICU treatment, even though the cited studies do not give exact percentages of patients who need extended ICU stays. For instance, it has been shown that male patients stay in intensive care units longer than female patients, which may be because of variations in the severity of their conditions and how well they respond to therapy [14]. There have also been reports of gender differences in ICU outcomes. Some studies have linked hospital mortality rates among postoperative intensive care unit patients to the male gender [15]. Additionally, males were more likely than women to die in hospitals among patients on mechanical ventilation, particularly among the elderly [15]. These disparities may be caused by biological differences, changes in comorbid conditions, and differences in the way care is provided. According to international studies, the majority of intensive care unit patients are men, with an average age between the mid-50s and the early 60s. Longer ICU stays are associated with higher rates of morbidity and resource utilization, underscoring the significance of focused interventions to shorten ICU stays. The need to add sex-specific components to critical care therapy to enhance patient outcomes is highlighted by gender disparities in intensive care unit results.

The emergence of MDR bacteria, particularly CRKP, is a major global public health concern. Serious resistance trends are evident in the current data, particularly with regard to β-lactam antibiotics. The extremely low sensitivity to ampicillin-sulbactam (2.32%) and overall resistance to ampicillin (0% sensitivity) are consistent with global research demonstrating that *K. pneumoniae* is inherently resistant to aminopenicillins due to its production of β-lactamase [17]. Similarly, imipenem (3.2% sensitivity) and meropenem (8.1% sensitivity) exhibit carbapenem resistance, supporting data from worldwide surveillance investigations that indicate the dissemination of CRKP isolates [18].

Research from Asia and Europe, where *K. pneumoniae* that generates ESBL has been often documented, is consistent with the limited resistance to third-generation cephalosporins shown with ceftriaxone (5.6%)

and cefepime (5.35%) [19]. First-line cephalosporins are no longer effective against these resistant bacteria, as seen by their sensitivity to cefuroxime (8.5%).
Although sensitivity was significantly increased by aminoglycosides such as gentamicin (16.39%) and amikacin (19.3%), resistance is still a concern. Despite increasing resistance rates, a number of studies show that amikacin is still a good treatment for MDR infections [20]. Levofloxacin (3.2%) and ciprofloxacin (3.9%), two fluoroquinolones, did not work very well. This is consistent with global reports of fluoroquinolone-resistant *K. pneumoniae* due to mutations in the DNA gyrase gene and efflux pump mechanisms [21].
The modest efficacy of cotrimoxazole (11.8%) and piperacillin-tazobactam (6.5%) is consistent with earlier research demonstrating that these medications are ineffective against MDR bacteria [22]. Growing antimicrobial resistance highlights the need for caution when using antibiotics, rapid detection technologies, and the development of novel therapies to mitigate the global effect of MDR bacteria.

Recommendations of the present study:
Execution of antimicrobial stewardship program and antibiotic policies. A systematic search for resistance genes at the molecular level. The enhanced infection control measures in intensive care units investigate innovative therapeutic alternatives, such as combination therapy.

Conclusion:
This study demonstrates the concerning trend of *K. pneumoniae* detected in endotracheal aspirates from intensive care unit patients becoming increasingly resistant to medications. We must take immediate action due to the prevalence of ESBL and carbapenemase-producing bacteria. Among the actions that may be taken include the prudent use of antibiotics, effective infection management, and continuous resistance monitoring.

Conflict of interest:
There is no conflict of interest among the present study authors.

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