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Pan-Drug Resistant *Klebsiella Pneumoniae* — An Emerging Threat In Clinical Microbiology-A Case Series.

Author

Abstract
Carbapenem-resistant Klebsiella pneumoniae (CRKP) has emerged as a major healthcare-associated pathogen with limited therapeutic options. Colistin, widely used as salvage therapy for carbapenem-resistant Enterobacterales, is increasingly compromised by emerging resistance. This case series describes the clinical profile, microbiological characteristics, antimicrobial susceptibility pattern, and outcomes of colistin-resistant CRKP infections identified in a tertiary-care centre. Four clinically significant cases of colistin-resistant CRKP were identified retrospectively, including two cases of ventilator-associated pneumonia, one orthopaedic wound infection, and one neonatal bloodstream infection. Organism identification and antimicrobial susceptibility testing were performed using standard microbiological methods and confirmed by VITEK2. Colistin minimum inhibitory concentration was determined by broth microdilution method. All isolates were resistant to carbapenems and colistin (MIC 4–8 µg/mL), while tigecycline retained in-vitro activity against all isolates. Three patients improved following tigecycline-based therapy and were discharged, whereas one elderly patient with severe sepsis and multiorgan dysfunction succumbed to illness. The emergence of colistin-resistant CRKP represents a serious therapeutic and infection control challenge, indicating progression toward extensively drug-resistant or pan-drug-resistant phenotypes. Early microbiological detection using reliable colistin susceptibility testing methods, strict infection prevention practices, and robust antimicrobial stewardship are essential to limit further emergence and spread of these organisms.

Keywords: *Colistin resistance; Carbapenem resistance; Pan-drug resistance Klebsiella pneumoniae;*

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I. Introduction:

Antimicrobial resistance (AMR) has become one of the most critical threats to global health, with India being among the highest burden countries due to extensive antimicrobial consumption, broad-spectrum empiric therapy, and high healthcare-associated infection rates. The ICMR antimicrobial resistance surveillance network and national reporting systems have repeatedly documented rising resistance among Gram-negative pathogens, particularly within intensive care settings. [1]

Klebsiella pneumoniae is a major cause of healthcare-associated infections including ventilator-associated pneumonia, bloodstream infection, complicated urinary tract infection, intra-abdominal infection, and surgical site infection.[2] The organism's ability to rapidly acquire resistance, survive in the hospital environment, and colonize patients, facilitates its outbreaks and endemic transmission. [3] Carbapenem resistance in *K. pneumoniae* is largely driven by carbapenemase production (e.g., NDM and OXA-48-like enzymes), often accompanied by ESBLs and additional non-β-lactam resistance mechanisms, resulting in multidrug resistance and limited treatment options.[4]

Colistin, reintroduced as salvage therapy for carbapenem-resistant Enterobacterales (CRE), has been widely used in ICUs. However, increased colistin use often for empiric cover has further added to its resistance. Colistin resistance may arise from chromosomal changes affecting lipid A modification (pmrAB, phoPQ, mgrB alterations) and plasmid-mediated mechanisms (mobilized colistin resistance genes such as *mcr*), raising concern for rapid horizontal dissemination[5, 6]

The rise of colistin resistance in CRKP has major clinical implications:
1. Narrowing therapeutic options
2. Increased risk of treatment failure and mortality in severe infections;
3. Increased outbreak potential in icu/nicu. [7]

In this context, we present four cases of colistin-resistant CRKP isolated from different clinical settings, highlighting the emerging threat and the need for robust diagnostics, stewardship, and infection control.

II. Materials And Methods

Study design and setting: Retrospective case series from a tertiary-care hospital.
Case selection: All patients with CRKP isolates showing colistin resistance (MIC ≥4 µg/mL).

Microbiology: Culture and identification were performed using standard microbiological procedures and confirmed by VITEK^2**.** AST was performed using VITEK^2. Colistin MIC by microbroth dilution method.
Data collection: Clinical data included age, diagnosis, comorbidities, sample type, ICU stay, exposure to broad-spectrum antibiotics, treatment, and outcome.

III. Case Descriptions

Case 1: A 77year old male patient referred to our hospital with complaints of fever for past two days. Patient had altered sensorium and breathlessness. There was a single episode of vomiting. No other known co-morbidities and but was newly diagnosed with T2DM. Patient had suffered head trauma by a bull attack, 15 years back. Patient admitted in ICU and diagnosed with septic encephalopathy with AKI, ALI and thrombocytopenia. Empirically started with ceftriaxone and doxycycline. Intubated due to ineffective airway clearance. Antibiotics were hiked to meropenem. Endotracheal aspirate was sent for microbiological analysis which yielded growth of *Klebsiella pneumoniae*. Tigecycline was added to the treatment regime after culture sensitivity report. Later patient had cardiac arrest and could not be revived with CPR and died.

Case 2: A 40 years old male patient had suffered open type III displaced comminuted right tibia fracture with ipsilateral fibula fracture at proximal third region along with closed displaced medial condyle fracture of right femur, after fall from his two wheeler. There was no history of head injury, loss of consciousness, vomiting or seizures. No known co-morbidities. Patient underwent knee spanning ex-fix application for right tibia fracture along with ORIF+MIPPO plating and CRIF screw fixation for condylar fracture. Wound debridement done. Patient was started on augmentin, amikacin and metrogyl. There was continuous pus discharge from the wound site which was sent for microbiological analysis on three different days, all of which yielded growth of *Klebsiella pneumoniae*, sensitive to tigecycline and cotrimoxazole. Patient was started on tigecycline after culture sensitivity report along with wound toileting.

Case 3: A term, appropriate for gestational age (40 weeks + 4 days) male baby delivered vaginally with vacuum assistance, did not cry immediately after birth, had respiratory distress secondary to birth asphyxia. Baby had a single episode of seizure at 22 hours of life. Later diagnosed with hepatic encephalopathy Grade III. Empirically treated with cefotaxime and amikacin. CRP was positive. Antibiotics hiked to tigecycline and colistin. Fluconazole was added to treatment regime. Blood culture sent for microbiological analysis yielded growth of *Klebsiella pneumoniae*, sensitive only to tigecycline. Treated only with tigecycline following culture sensitivity report. Baby improved and haemodynamically stable before being discharged.

Case 4: A 48year old female underwent fronto-temporo parietal craniotomy in past, following RTA, was admitted to our hospital for decompressive craniectomy with posterior sylvian hematoma evacuation and lax duroplasty. Known case of T2DM and HTN. CT Brain revealed large hypodense area in right fronto-temporo-parietal lobe. Patient shifted to ICU post surgery and started on piperacillin-tazobactam, amikacin and meropenem. Colistin was added owing to the deteriorating condition of the patient. Endotracheal aspirate sent for culture analysis. *Klebsiella pneumoniae* grown in culture which was sensitive only to tigecycline. Patient was started on tigecycline after culture sensitivity report.

Case	Age/Sex	Underlying conditions	Prior colistin	Colistin MIC (µ/ml)	Therapy given	Outcome
1.	77/M	Septic encephalopathy	No	8	Tigecycline	Died
2.	40/M	Open type III displaced comminuted right tibia fracture	No	10	Tigecycline + Cotrimoxazole	Discharged
3.	0/M	Hepatic encephalopathy	Yes	8	Tigecycline + Fluconazole	Discharged
4.	48/F	Fronto-temporal parietal craniotomy	Yes	4	Tigecycline	Discharged

IV. Discussion

This case series illustrates the clinical emergence of colistin-resistant CRKP across high-risk settings. Indian surveillance reports and institutional studies have demonstrated alarmingly high rates of carbapenem resistance in *K. pneumoniae*, with progressive decline in susceptibility to multiple antibiotic classes. Recent national datasets indicate *K. pneumoniae* is among the top drivers of AMR burden in blood, respiratory, and urine cultures, with increasing resistance even to “reserve” agents such as colistin.

The resistance phenotype observed in our isolates reflects the typical CRKP profile in India where NDM/OXA-48-like carbapenemases coexist with resistance determinants to fluoroquinolones and aminoglycosides, producing extreme drug resistance. Therapeutic options are narrowed to tigecycline, aminoglycosides in a small subset, and newer BL-BLI combinations where feasible. [8] The dependence on tigecycline as demonstrated in our cases mirrors the reality of clinical practice in many Indian tertiary centres.

The NICU bloodstream infection case is especially concerning given Indian data documenting NICU outbreaks of MDR and carbapenemase-producing *K. pneumoniae*, including strains with high transmissibility and limited therapy. Outbreak settings worsen patient outcomes, prolong hospitalization, and accelerate institutional spread. [9]

From a diagnostic perspective, accurate colistin susceptibility testing is critical, since diffusion methods are unreliable for colistin. Broth microdilution remains the reference method. [10] Recent Indian microbiology evaluations have shown performance gaps in alternative phenotypic tests and highlight the need for laboratories to adopt recommended methods, particularly in ICU settings where treatment decisions are time-sensitive.

Clinically, mortality in colistin-resistant CRKP infections is influenced by host factors (elderly age, shock, organ failure), disease severity, delays in appropriate therapy, and limited drug choices. Our mortality (25%) occurred in the most severe illness profile, supporting the role of comorbidity and multiorgan dysfunction.

Overall, colistin resistance among CRKP represents a critical inflection point, indicating possible transition to extensively drug-resistant or pan-drug-resistant phenotypes. A multipronged approach is necessary- Strengthening laboratory capacity with MIC-based colistin testing and prompt reporting, implementing antimicrobial stewardship with rational colistin use and de-escalation policies, enforcing strict infection prevention measures, and enhancing surveillance with molecular detection of resistance genes are essential to control the emergence and spread of colistin-resistant CRKP.

V. Conclusion:

Colistin-resistant CRKP is an alarming emerging pathogen in hospital practice with limited therapeutic options and high potential for ICU/NICU spread. Early microbiological detection using reliable colistin MIC methods, strict infection control, and robust antimicrobial stewardship are essential to prevent escalation toward untreatable infections.

Patient Consent

Appropriate informed consent was obtained from the patients/guardians for publication of clinical details. Patient identity has been adequately anonymized and confidentiality has been maintained.

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Competing Interest

The authors declare no competing interests.

References:

[1]. Indian Council Of Medical Research. Antimicrobial Resistance Surveillance & Research Network (AMRSN): Annual Report January 2024–December 2024. New Delhi: ICMR; 2025. Available From: ICMR AMRSN Portal/PDF.

[2]. Kalil AC, Metersky ML, Klompas M, Muscedere J, Sweeney DA, Palmer LB, Et Al. Management Of Adults With Hospital-Acquired And Ventilator-Associated Pneumonia: 2016 Clinical Practice Guidelines By The Infectious Diseases Society Of America And The American Thoracic Society. Clin Infect Dis. 2016;63(5):61-111.

[3]. Raj S, Sharma T, Pradhan D, Tyagi S, Gautam H, Singh H, Et Al. Comparative Analysis Of Clinical And Genomic Characteristics Of Hypervirulent Klebsiella Pneumoniae From Hospital And Community Settings: Experience From A Tertiary Healthcare Center In India. Microbiol Spectr. 2022;10(5):00376-22.

[4]. Azam M, Gaind R, Yadav G, Sharma A, Upmanyu K, Jain M, Et Al. Colistin Resistance Among Multiple Sequence Types Of Klebsiella Pneumoniae Is Associated With Diverse Resistance Mechanisms: A Report From India. Front Microbiol. 2021;12:609840.

[5]. Kanaujia R, Jamir I, Arora N, Biswal M, Sharma N, Ray P, Et Al. Risk Factors And Clinical Outcomes In Patients With Colistin-Resistant Klebsiella Pneumoniae Bloodstream Infection: A Retrospective Analysis. Indian J Med Microbiol. 2025;56:100882.

[6]. Zahedi Bialvaei A, Eslami P, Ganji L, Dolatyar Dehkharghani A, Asgari F, Koupahi H, Et Al. Prevalence And Epidemiological Investigation Of Mgrb-Dependent Colistin Resistance In Extensively Drug Resistant Klebsiella Pneumoniae In Iran. Sci Rep. 2023;13(1):10680.

[7]. Balkhair A, Saadi KA, Adawi BA. Epidemiology And Mortality Outcome Of Carbapenem- And Colistin-Resistant Klebsiella Pneumoniae, Escherichia Coli, Acinetobacter Baumannii, And Pseudomonas Aeruginosa Bloodstream Infections. IJID Reg. 2023;7:1-5.

[8]. Yusof NY, Norazzman NI, Hakim SN, Azlan MM, Anthony AA, Mustafa FH, Et Al. Prevalence Of Mutated Colistin-Resistant Klebsiella Pneumoniae: A Systematic Review And Meta-Analysis. Trop Med Infect Dis. 2022;7(12):414.
[9]. Pathak A, Tejan N, Dubey A, Chauhan R, Fatima N, Jyoti, Et Al. Outbreak Of Colistin Resistant, Carbapenemase (Blandm, Blaoxa-232) Producing Klebsiella Pneumoniae Causing Bloodstream Infection Among Neonates At A Tertiary Care Hospital In India. Front Cell Infect Microbiol. 2023;13:1051020.
[10]. Clinical And Laboratory Standards Institute. Performance Standards For Antimicrobial Susceptibility Testing. 35th Ed. CLSI Supplement M100. Wayne (PA): CLSI; 2025.