Indian J Med Res 163, April 2026, pp 505-519
DOI: 10.25259/IJMR_2824_2025

Systematic Review

Carbapenem resistance and associated resistance genes in enterobacteriaceae and non-enterobacteriaceae in India: A systematic review and meta-analysis

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Received October 13, 2025; Accepted January 5, 2026; Published April 27, 2026

Background and objectives: Carbapenems are highly potent antibiotics, and the emergence and spread of carbapenem resistance is a major global public health challenge. This systematic review and meta-analysis investigated the prevalence of carbapenem resistance in Enterobacteriaceae and non-Enterobacteriaceae in India and delineated the spectrum of genes associated with carbapenem resistance in carbapenem-resistant organisms.

Methods: A comprehensive systematic review of available electronic databases was conducted in accordance with PRISMA guidelines. Studies on human samples from India reporting phenotypic and genotypic data for carbapenem-resistant Enterobacteriaceae (CRE) and carbapenem-resistant non-Enterobacteriaceae (CRNE) were included. Pooled prevalence rates were determined using a random effects model to account for heterogeneity. Data analyses were performed using Meta-Analysis Online software.

Results: A total of 45 studies met the inclusion criteria. The pooled prevalence of CRE was 9% (0.07–0.11) and CRNE was 16% (0.09–0.24), with marked heterogeneity (I^2=99%, P<0.001). Within Enterobacteriaceae, *Escherichia coli* and *Klebsiella spp*. exhibited the highest levels of carbapenem resistance. Among non-Enterobacteriaceae, *Acinetobacter spp*. and *Pseudomonas spp*. were the predominant resistant organisms. Genotypic analysis revealed that, among metallo β-lactamases, bla_{NDM-1} and bla_{VIM-1} were the most frequently reported genes in CRE and CRNE, while bla_{OXA-48} was the major determinant in CRE, whereas bla_{OXA-23} and bla_{OXA-51} predominated in CRNE, among the serine β-lactamases.

Interpretation and conclusions: This meta-analysis identified diverse carbapenem-resistant organisms and genetic determinants in both CRE and CRNE. Regional variation in prevalence was evident, with a notable lack of data from Central India. The findings identify lacunae in reporting, emphasise on circulating genes, and highlight the urgent need for strengthening nationwide surveillance to help formulate robust evidence-based strategies for combating carbapenem resistance.

Keywords Carbapenem resistant; Carbapenem resistant genes; Enterobacteriaceae; India; Non-Enterobacteriaceae; Prevalence

Antibiotic resistance is a growing global concern, with