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? ICMR Study Highlights Rising Carbapenem Resistance and the Growing Health and Economic Burden of Antimicrobial Resistance in India

Published On: 10-09-2026

Recent Developments:

- A recent **Indian Council of Medical Research (ICMR)** study has highlighted that infections caused by **carbapenem-resistant Gram-negative bacteria** are associated with higher mortality and greater antibiotic expenditure than infections caused by drug-susceptible strains.
- The study was conducted through the **ICMR Antimicrobial Resistance Surveillance Network** across **20 tertiary-care hospitals** between April 2022 and April 2025, providing important real-world evidence on resistant infections in Indian healthcare settings.
- Mortality was consistently higher among patients infected with carbapenem-resistant strains of four major Gram-negative pathogens, with the **relative risk of death ranging from 1.16 to 1.43 times** compared with susceptible infections.
- More than **61% of Gram-negative infections** examined in the study were carbapenem-resistant, indicating a serious therapeutic challenge for Indian hospitals.
- The findings are particularly significant because India launched **National Action Plan on Antimicrobial Resistance 2.0 (NAP-AMR 2.0) for 2025–2029** in November 2025, with greater emphasis on inter-sectoral coordination, laboratory capacity, infection prevention, private-sector participation and a **One Health approach**.
- WHO India's 2026 AMR updates continue to emphasise **infection prevention and control, diagnostic stewardship, antimicrobial stewardship and One Health coordination** as central components of AMR containment.

Understanding Antimicrobial Resistance and Carbapenem Resistance:

What is Antimicrobial Resistance?

- **Antimicrobial Resistance (AMR)** occurs when microorganisms evolve mechanisms that reduce or eliminate the effectiveness of medicines used against them, making infections harder to treat and increasing the risks of prolonged illness, transmission, healthcare expenditure and death.
- AMR includes resistance among **bacteria, viruses, fungi and parasites**, although bacterial resistance remains a major focus of India's national AMR strategy.
- **Antibiotic resistance** is the bacterial component of AMR and is particularly important because bacterial infections are common in hospitals and communities.

Why Gram-Negative Bacteria Matter?

- **Gram-negative bacteria** possess a thin peptidoglycan layer and an outer membrane containing **lipopolysaccharides**, causing them to appear pink or red during Gram staining.

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- Important Gram-negative pathogens include **Escherichia coli, Klebsiella pneumoniae, Acinetobacter baumannii and Pseudomonas aeruginosa**, which can cause urinary tract, respiratory, wound and bloodstream infections.
- Their outer membrane and multiple resistance mechanisms can make treatment difficult, particularly when they acquire resistance to several antibiotic classes.

Why Carbapenems Are Important?

- **Carbapenems** are broad-spectrum antibiotics used primarily for severe infections caused by multidrug-resistant Gram-negative bacteria.
- They are often reserved for situations where commonly used antibiotics are ineffective, making them an important component of the clinical **last-line treatment arsenal**.
- **Carbapenem resistance** therefore substantially reduces therapeutic options and can force clinicians to rely on newer, more expensive or potentially more toxic alternatives.
- ICMR has separately issued guidance on the diagnosis and management of **carbapenem-resistant Gram-negative infections**, reflecting the clinical importance of this resistance pattern.

Key Findings and Their Significance:

Higher Mortality and Severe Clinical Outcomes:

- The ICMR study found consistently higher mortality among patients with **carbapenem-resistant infections**, but resistance should not be interpreted as the sole independent cause of death.
- Outcomes are also influenced by **severity of illness, delayed effective therapy, source control, comorbidities and patient characteristics**, making carbapenem resistance an important marker of excess mortality rather than an isolated determinant.
- The finding is particularly concerning for **bloodstream infections**, where delayed administration of an effective antibiotic can rapidly worsen clinical outcomes.

Healthcare-Associated Transmission:

- More than **85% of bloodstream infections** in the study were healthcare-associated, highlighting the major role of hospitals in the transmission and amplification of resistant pathogens.
- Risk factors include **invasive medical devices, recent surgery, prolonged hospitalisation, antibiotic pressure, inadequate infection prevention and delayed diagnosis**.
- Therefore, India's AMR challenge cannot be reduced to inappropriate antibiotic consumption alone; healthcare-associated transmission can sustain resistance even when antibiotic prescribing is improved.

Economic Burden:

- Antibiotic expenditure for resistant infections was approximately **1.1 to 2 times higher** than for susceptible infections in the study.
- The researchers considered only antibiotic costs based on medicines available through the **Jan Aushadhi** framework and excluded ICU charges, hospital beds, diagnostics, procedures, supportive care and consultation expenses.
- The actual economic burden is therefore likely to be considerably higher for patients, families and the healthcare system.
- AMR consequently represents both a **public health challenge and an economic development concern**, particularly because prolonged illness increases healthcare expenditure and productivity losses.

Ceftazidime-Avibactam and the Need for Better Evidence:

Emerging Therapeutic Options:

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- **Ceftazidime-avibactam** was associated with better outcomes in some resistant **E. coli and Klebsiella pneumoniae** infections, including bloodstream infections.
- However, the study was **observational**, so the findings do not establish definitive superiority over all alternative treatments.
- Differences in disease severity, timing of therapy, resistance mechanisms and treatment selection can influence outcomes, limiting the interpretation of observational comparisons.
- The broader lesson is that India needs **rapid diagnostics and antimicrobial susceptibility testing** to identify the right medicine instead of routinely escalating to newer broad-spectrum antibiotics.

AMR as an Infection-Control Challenge:

Why Antibiotics Alone Cannot Solve AMR?

- Excessive antibiotic use creates **selective pressure**, allowing resistant organisms to survive and multiply, but transmission within healthcare settings can further spread these organisms.
- **Hand hygiene, environmental cleaning, sterilisation, surgical infection prevention and appropriate isolation practices** can reduce transmission without creating additional antibiotic pressure.
- Prevention is therefore often more sustainable than repeatedly developing or deploying stronger antibiotics.

Antimicrobial Stewardship:

- **Antimicrobial stewardship** means ensuring that the right antimicrobial is prescribed for the right patient, infection, dose, route and duration.
- Hospitals should strengthen prescription audits, local antibiograms, diagnostic stewardship, de-escalation of empirical therapy and review of antibiotic duration.
- The objective is not simply to reduce antibiotic consumption but to achieve **effective treatment while minimising unnecessary antimicrobial exposure**.

India's Policy Response and the One Health Approach:

National Action Plan on AMR 2.0:

- India launched **NAP-AMR 2.0 (2025–2029)** to address gaps identified during implementation of the first national plan and strengthen coordinated action across sectors.
- The updated framework provides **specific action plans, timelines and budgets** for stakeholder ministries and strengthens coordination across health, animal husbandry, agriculture, environment, science and other relevant sectors.
- The plan gives greater importance to **laboratory capacity, infection prevention and control, antimicrobial stewardship, research, diagnostics, innovation and private-sector engagement**.
- NCDC currently supports national AMR surveillance through standardised **surveillance protocols, laboratory practices, WHONET-based reporting and antimicrobial consumption surveillance**, strengthening evidence-based policymaking.

One Health Framework:

- AMR crosses the boundaries of **human health, animal health, agriculture, food systems and the environment**, requiring coordinated surveillance and interventions across sectors.
- Antibiotic use in humans and animals, pharmaceutical and agricultural waste, contaminated water and environmental dissemination can contribute to the broader AMR ecosystem.
- NAP-AMR 2.0 therefore adopts a **One Health approach** rather than treating AMR exclusively as a hospital or clinical problem.

Way Forward:

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Strengthen Surveillance and Diagnostics:

- India should move beyond isolate-based surveillance towards **integrated surveillance linking laboratory findings with treatment, clinical outcomes, mortality and antimicrobial consumption**.
- Rapid and affordable diagnostics should enable early identification of pathogens and resistance mechanisms, reducing unnecessary empirical antibiotic use.
- Genomic surveillance can further help identify **transmission pathways, emerging resistance mechanisms and high-risk clones**.

Strengthen Infection Prevention:

- Hospitals should institutionalise **hand hygiene, environmental sanitation, device-associated infection prevention, appropriate insertion and early removal of invasive devices, surgical infection prevention and healthcare-associated infection surveillance**.
- Infection prevention should be treated as a core patient-safety function rather than merely an administrative programme.

Improve Antimicrobial Stewardship:

- Stewardship programmes should become a routine part of clinical practice across public and private healthcare facilities.
- Antibiotic policies should be guided by **local resistance patterns, culture and susceptibility results, treatment guidelines and regular prescription audits**.
- Access to effective antibiotics must be balanced with measures that prevent their inappropriate use.

Invest in Innovation and Responsible Access:

- India needs greater investment in **new antibiotics, rapid diagnostics, vaccines, alternative therapeutics and antimicrobial-resistance research**.
- Newer antimicrobials should be protected through stewardship so that their effectiveness is preserved for patients who genuinely require them.
- Public-private partnerships and sustained financing can help address the market and research failures associated with antibiotic development.

Conclusion:

- The ICMR findings demonstrate that **carbapenem resistance is simultaneously a clinical, economic and public-health threat**, particularly in healthcare-associated and severe infections.
- India's AMR challenge cannot be solved by developing a new antibiotic whenever an existing drug becomes ineffective.
- The sustainable response requires an integrated strategy based on **infection prevention, rapid diagnosis, antimicrobial stewardship, surveillance, responsible access to newer drugs and One Health coordination**.
- The success of **NAP-AMR 2.0** will ultimately depend on translating national policy into measurable improvements in hospitals, laboratories, communities, animal health systems and the environment.

Value Addition for UPSC:

Essay and Ethics Linkages:

- AMR can be framed through the principle that **prevention is more sustainable than technological escalation**.
- It also raises questions of **intergenerational equity**, because inappropriate antibiotic use today can reduce the effectiveness of essential medicines available to future generations.

Mains Enrichment:

- **Keywords:** Antimicrobial Resistance, Carbapenem Resistance, Gram-Negative Bacteria, Antimicrobial Stewardship, Infection Prevention and Control, Healthcare-Associated Infections, Diagnostic Stewardship, One Health, Genomic Surveillance, NAP-AMR 2.0.
- **Core argument:** *“AMR is not merely an antibiotic problem; it is a systems problem involving diagnosis, infection prevention, prescribing behaviour, healthcare transmission, surveillance and the One Health interface.”*
- **Policy anchor:** **NAP-AMR 2.0 (2025–2029)** provides India with a framework to convert this systems-level understanding into coordinated national action.