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The Overuse of Antibiotics and the Antimicrobial Resistance Crisis in India: A Review of Evidence, Health Impact, and Calls for Action

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Abstract

The overuse and misuse of antibiotics in India have fostered a rapidly growing antimicrobial resistance (AMR) crisis, jeopardizing the efficacy of standard treatments for common infections, increasing morbidity and mortality, and straining the national health system. This review synthesizes existing literature on antibiotic consumption patterns, social and systemic drivers of misuse, the prevalence and trends of resistant pathogens in clinical and community settings, and the broader health consequences of AMR in India. We also examine ongoing national initiatives, challenges in implementation, and propose multi-sectoral strategies — including antibiotic stewardship, enhanced surveillance, public education, and a One-Health approach — to mitigate the AMR threat. Without urgent and sustained action, India risks sliding into a post-antibiotic era where even routine infections become difficult or impossible to treat.

Keywords- antibiotics, antimicrobial resistance (AMR) crisis, India, mortality.

Introduction

Antibiotics — among modern medicine's greatest achievements — have transformed the ability to treat bacterial infections, turning once-deadly diseases into manageable or curable conditions. However, their widespread availability and frequent misuse have led to an unintended consequence: the emergence and proliferation of antimicrobial resistance (AMR). In India, overuse and misuse of antibiotics — in human health care, agriculture, veterinary use, and environmental contamination — have created conditions ripe for the evolution and spread of drug-resistant bacteria.

The phenomenon of AMR is not merely a laboratory concern: it threatens to undermine decades of public health gains, increase healthcare costs, worsen clinical outcomes, and limit the feasibility of routine medical procedures

like surgeries, chemotherapy, neonatal care, and intensive care. India — with its large and dense population, high burden of infectious diseases, and structural challenges in health regulation — is especially vulnerable.

This review aims to provide a comprehensive, evidence-based synthesis of the extent and drivers of antibiotic overuse in India, current data on AMR prevalence and trends, health impacts and systemic risks, and actionable recommendations to address the crisis.

Antibiotic Use and Misuse in India — Patterns and Drivers

Antibiotic use in India has increased dramatically over the past two decades. According to data from the Indian Council of Medical Research (ICMR), antibiotic consumption more than doubled between 2000 and 2015. A more recent analysis covering 2011–2019 showed that although the overall defined daily doses (DDD) per 1,000 inhabitants per day (DID) decreased modestly by 3.6%, the composition of consumption shifted towards more potent "Watch" and "Reserve" antibiotics, while the proportion of the safer "Access" antibiotics fell. The share of "Reserve" group antibiotics — those meant for severe or resistant infections — increased over this period (compound annual growth rate ~16.8%).

This shift is worrisome: it suggests not only high-volume use but a trend toward broader-spectrum and last-line antibiotics — which risks selecting for more resistant pathogens.

Multiple interlinked factors contribute to antibiotic overuse and irrational use in India. These include over-the-counter access and weak regulation, empirical and prophylactic prescribing without diagnostics, low public awareness, self-medication and incomplete courses, use of antibiotics in animal husbandry and agriculture, inadequate infection control and sanitation, and various socioeconomic and structural constraints.

Combined, these drivers create a fertile ground for evolution and dissemination of AMR across community and hospital settings — and even in the environment.

The Nature of Antimicrobial Resistance and Its Mechanisms

The World Health Organization (WHO) defines antimicrobial resistance (AMR) as the ability of microorganisms (bacteria, viruses, fungi, parasites) to resist antimicrobial agents that were previously effective against them. Over time, microbes may develop or acquire resistance mechanisms — via spontaneous mutation or horizontal gene transfer (e.g., plasmids, integrons, transposons) — enabling survival even in the presence of therapeutically relevant drug concentrations. Once resistance genes become established, they can spread through populations and across ecological compartments (human, animal, environment).

When bacteria become resistant to multiple classes of antibiotics — including last-line agents — they are often referred to as "superbugs," posing a grave threat to modern medicine.

Excessive antibiotic use (especially broad-spectrum and last-line drugs), misuse (sub-therapeutic doses, incomplete courses), empirical prophylactic use without diagnosis, and frequent exposure across sectors provide strong selective pressure. This favors survival and expansion of resistant strains, and enables horizontal transfer of resistance genes, thus accelerating the emergence and spread of multidrug-resistant (MDR) and extensively drug-resistant (XDR) pathogens.

Environmental factors (e.g., inadequate wastewater treatment, contamination of surface water and soil, livestock waste) further propagate resistance reservoirs, expanding risk beyond hospitals and individual patients.

The Burden and Trends of AMR in India

Recent data paint a disquieting picture of widespread and entrenched AMR in India. A large multi-country study published in 2025 found that 83% of Indian patients (across multiple centres) carried multidrug-resistant

organisms (MDROs) — the highest proportion globally and far exceeding rates in high-income countries. Commonly carried pathogens included extended-spectrum β-lactamase (ESBL)-producing bacteria and carbapenem-resistant Gram-negatives.

Such high carriage rates suggest that resistance is not restricted to hospitalised, critically ill patients — but is widespread across the community and general patient population, including individuals undergoing elective procedures.

Data from 2019 estimate approximately 297,000 deaths directly attributable to AMR in India, with around 1,042,500 deaths associated with AMR as a contributing factor. The highest mortality occurs among key pathogens such as Escherichia coli, Klebsiella pneumoniae, Staphylococcus aureus, Acinetobacter baumannii, and Mycobacterium tuberculosis.

Evidence also indicates AMR is widespread in community settings, dental practice, and environmental reservoirs such as water bodies, soil, and agricultural runoff, highlighting that AMR is both a clinical and ecological problem.

The shift away from "Access" antibiotics toward "Watch" and "Reserve" groups signals increasing reliance on broad-spectrum and last-resort drugs, possibly as a consequence of rising resistance to first-line agents.

Health and Systemic Implications of AMR in India

AMR directly undermines the effectiveness of standard antibiotic therapies, leading to treatment failures, prolonged illness, increased risk of complications, and higher mortality. Infections such as urinary tract infections, bloodstream infections, pneumonia, surgical-site infections, neonatal sepsis, skin and soft tissue infections — once routinely treated — now often require second- or third-line drugs, which may be more expensive, more toxic, or less accessible.

For vulnerable populations — children, neonates, elderly, immunocompromised patients, those with chronic conditions, and patients undergoing surgery or intensive care — AMR significantly raises the risk of adverse outcomes.

Economically, treating drug-resistant infections is significantly costlier than treating drug-sensitive ones due to more expensive antibiotics, longer hospital stays, additional diagnostics, and supportive care. This imposes heavy out-of-pocket expenses on patients and increases the burden on the healthcare system.

AMR also threatens the feasibility of many routine and advanced medical interventions: surgeries, organ transplants, chemotherapy, neonatal intensive care, and dialysis rely on effective antibiotics. Rising AMR erodes decades of public health gains and undermines infectious disease control, particularly in settings with limited diagnostic capacity and weak infection-prevention infrastructure.

Beyond human health, AMR in the environment — driven by antibiotic use in animals, aquaculture, and agriculture — creates persistent reservoirs in water, soil, and food chains, with long-term ecological and public health consequences.

National and Policy Responses to AMR in India — Progress and Gaps

Recognizing the threat, the Government of India has launched several initiatives. The National Action Plan on AMR (NAP-AMR) was introduced in 2017, aligned with the WHO Global Action Plan. Earlier, the National Task Force on AMR (2010) and the 2012 Chennai Declaration by Indian medical societies called for rational antibiotic use and stewardship.

Laboratory surveillance networks under the Indian Council of Medical Research (ICMR) and other bodies monitor AMR patterns and antibiotic consumption. Public health campaigns and stewardship efforts have also been introduced, reflecting growing awareness.

Despite these efforts, enforcement of prescription-only antibiotic sales remains weak, public awareness is still low, diagnostic capacity is limited, surveillance systems are fragmented, and One-Health initiatives are underdeveloped. Translation of national policy into routine practice is slow, particularly in smaller hospitals, private clinics, and rural settings.

Challenges Specific to the Indian Context

India faces unique challenges that exacerbate AMR. These include a high infectious disease burden, socioeconomic constraints, regulatory and enforcement gaps, limited diagnostic infrastructure, environmental pressures, and underfunded public health systems.

In many areas, access to qualified healthcare providers is limited, leading patients to seek care from informal providers or self-medicate, both of which increase inappropriate antibiotic use. High population density, inadequate sanitation, and extensive antibiotic use in livestock farming and agriculture contribute to persistent environmental reservoirs of resistance.

Public health financing is relatively low, constraining investment in stewardship programmes, laboratory networks, infection prevention and control, and water and sanitation infrastructure.

Proposed Strategies and Recommendations to Combat AMR in India

Addressing AMR in India requires a committed, multi-sectoral, and sustained strategy.

1. Strengthen antibiotic stewardship in human healthcare: establish or scale antimicrobial stewardship programs (AMS) across hospitals and clinics, promote rational prescribing, integrate AMR education into medical and allied curricula, and expand diagnostic capacity, especially in rural and resource-limited settings.

2. Enforce regulation of antibiotic sales and dispensing: ensure antibiotics are sold only with valid prescriptions, conduct routine audits of pharmacies, and implement penalties for non-compliance. Public awareness campaigns should educate communities about self-medication risks, incomplete courses, and the difference between bacterial and viral infections.

3. Adopt a One-Health approach: regulate and monitor antibiotic use in livestock, poultry, aquaculture, and agriculture; improve farm biosecurity and vaccination; enhance wastewater treatment and environmental hygiene; and expand AMR surveillance to include environmental and animal-health sectors.

4. Strengthen national policy, surveillance, and data systems: fully implement and fund the National Action Plan on AMR, build integrated AMR surveillance networks with standardized reporting, and support research on novel therapies, diagnostics, vaccines, and low-cost interventions.

5. Promote equity, access, and healthcare strengthening: ensure equitable access to qualified care, diagnostics, and effective antibiotics for marginalized populations; invest in primary care infrastructure, clean water and sanitation; and encourage community engagement and behavioural change.

Discussion

The AMR crisis in India is structural and rapidly intensifying. A convergence of high infectious disease burden, widespread antibiotic access and misuse, environmental factors, weak regulation, and inadequate health infrastructure has created a system in which resistant pathogens thrive and spread.

The scale of AMR-associated mortality, the widespread carriage of multidrug-resistant organisms, and the shift toward increased use of last-line antibiotics all point to a future where many common infections may become difficult or impossible to treat. This undermines individual health, public health achievements, and the sustainability of the health system.

AMR threatens both treatment and prevention: procedures such as surgeries, chemotherapy, and neonatal intensive care depend on effective antimicrobials. If resistance continues unchecked, the viability of modern medical care in India could be severely compromised.

AMR is more than a clinical problem; it intersects with public policy, environment, agriculture, and socio-economic development. Only a coordinated, multi-sectoral, long-term response — integrating human health, animal health, agriculture, environment, and community behaviour — can contain this threat.

Conclusion

The overuse and misuse of antibiotics in India — driven by systemic, social, and ecological factors — has fuelled a deep and growing antimicrobial resistance (AMR) crisis. Evidence shows high and rising antibiotic consumption, shifting patterns toward potent "Watch/Reserve" antibiotics, widespread carriage of multidrug-resistant organisms, increasing resistance in bloodstream and community-acquired infections, and a heavy mortality and morbidity burden.

While the government and stakeholders have initiated policies and programmes, significant gaps remain in implementation, enforcement, data generation, and cross-sector coordination. The One-Health dimension — involving human health, agriculture, environment, and animal health — is still under-addressed.

Unchecked AMR threatens to roll back decades of progress in infection control, undermine standard treatments, and compromise the entire healthcare system. To avert this crisis, India needs urgent, sustained, and comprehensive action — encompassing antimicrobial stewardship, regulatory reform, surveillance, environmental and animal-health interventions, public education, and healthcare strengthening.

The antibiotic success story of the 20th century risks turning into a tragedy unless India (and the world) commits now to preserving antimicrobial efficacy for future generations.

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