ISSN: 2306-6091

**International Journal of Pharmaceuticals and Health care Research (IJPHR)**

**IJPHR |Vol.13 | Issue 2 | Apr - Jun -2025**

**www.ijphr.com**

DOI : https://doi.org/10.61096/ijphr.v13.(SPL 1).2025.259-263

**Review**

# A Short Review On Antibiotic Drug

**[1*]Ayush Pal, [2]Meenu Bhatt, [1]Abhilash Bisht**

*Research Scholar, Maya College of Pharmacy, Dehradun*
*Assistant Professor, School of Pharmacy, Maya Devi University, Dehradun*

*Author for Correspondence: Ayush Pal
Email: ayushpal701@gmail.com

Published on: 04 Jun 2025

Published by:
DrSriram Publications



## Abstract

Antibiotic drug abuse, characterized by the excessive or inappropriate use of antibiotics in humans and animals, is a growing global health crisis. This misuse occurs through overprescription (often for viral infections), patient non-adherence, self-medication, and rampant non-therapeutic use in agriculture. Drivers include patient demand, diagnostic uncertainty, economic incentives, weak regulations, and lack of public awareness. The most severe consequence is antimicrobial resistance (AMR), where bacteria evolve to withstand antibiotics, leading to untreatable "superbugs." AMR increases treatment failures, mortality rates, healthcare costs, and undermines critical medical procedures like surgeries and chemotherapy. Additionally, antibiotic abuse disrupts the microbiome, raises risks of infections like *C. difficile*, and pollutes the environment with resistant bacteria. Addressing this crisis demands a unified "One Health" strategy, integrating human, animal, and environmental health efforts. Key measures include enforcing antibiotic stewardship programs to promote responsible prescribing, improving public education on proper antibiotic use, and investing in rapid diagnostics to differentiate bacterial from viral infections. Stricter regulations on antibiotic access in human medicine and banning non-therapeutic agricultural use are essential.

**Keywords:** Antimicrobial resistance (AMR), Antibiotic resistance (ABR), Antibiotic misuse

## INTRODUCTION

### Antibiotic Drug Abuse - Undermining a Medical Miracle

The discovery of antibiotics revolutionized modern medicine, transforming once-fatal bacterial infections into treatable conditions and enabling medical breakthroughs such as complex surgeries, chemotherapy, organ transplants, and neonatal care. Since Alexander Fleming's identification of penicillin in 1928, these "miracle drugs" have saved millions of lives. However, their overuse and misuse—termed antibiotic drug abuse—now threaten to undo this progress by accelerating antimicrobial resistance (AMR), a phenomenon where bacteria evolve to withstand treatment, rendering antibiotics ineffective. This crisis stems from inappropriate prescribing in human medicine, patient misuse, and rampant overuse in agriculture, driven by systemic factors including economic incentives, lack of regulation, and insufficient public awareness. If left unchecked, AMR could return humanity to a pre-antibiotic era, where common infections become deadly and routine medical procedures carry life-threatening risks.

**Manifestations of Antibiotic Abuse**

Antibiotic abuse occurs across multiple sectors, with human healthcare and agriculture being the primary contributors. In clinical settings, overprescription is rampant, often due to diagnostic uncertainty, patient demand, or lack of rapid testing. Studies indicate that up to 50% of antibiotic prescriptions are unnecessary, particularly for viral infections like colds and flu, against which antibiotics are useless (CDC, 2021). Additionally, patient non-adherence—such as stopping antibiotics prematurely once symptoms improve—allows surviving bacteria to develop resistance. Self-medication, including the use of leftover antibiotics or purchasing them without prescriptions (common in countries with lax regulations), further exacerbates resistance (WHO, 2020). However, the agricultural sector is the largest consumer of antibiotics, accounting for over 70% of global use (FAO, 2017). In intensive farming, antibiotics are routinely administered not just for treating infections but as growth promoters and prophylactics in crowded, unsanitary conditions. This sub-therapeutic dosing creates ideal conditions for resistant bacteria to thrive, entering the food chain and environment through manure, water runoff, and meat consumption. The widespread use of colistin, a last-resort antibiotic, in livestock has already led to the emergence of mcr-1, a resistance gene transferable to humans, posing a dire public health threat (Liu et al., 2016).

**Drivers of Antibiotic Misuse**

The root causes of antibiotic abuse are multifaceted. Cultural and behavioral factors play a significant role, with many patients demanding antibiotics for minor illnesses, believing they offer a quick fix. Healthcare providers, facing time constraints and diagnostic uncertainty, often comply rather than risk complications (Llor & Bjerrum, 2014). Economic incentives also drive misuse pharmaceutical companies promote antibiotic sales, while industrial farms rely on them to maximize production in high-density livestock operations.

Weak regulatory frameworks further enable abuse. In many low- and middle-income countries, antibiotics are available over-the-counter without prescriptions, while agricultural use remains poorly monitored (Van Boeckel et al., 2015). The lack of rapid diagnostic tests means physicians often prescribe antibiotics empirically (without confirming bacterial infection), increasing misuse. Globalization accelerates the spread of resistant bacteria through travel, food trade, and migration, making AMR a borderless threat (O'Neill, 2016).

**Consequences of Antibiotic Abuse: The AMR Crisis**

The most catastrophic outcome of antibiotic abuse is antimicrobial resistance (AMR), where bacteria evolve mechanisms to evade drugs. Misuse accelerates this natural process, leading to multi-drug-resistant (MDR), extensively drug-resistant (XDR), and pan-drug-resistant (PDR) superbugs. Some strains, such as MRSA (methicillin-resistant *Staphylococcus aureus*) and carbapenem-resistant *Enterobacteriaceae* (CRE), are already untreatable with most available antibiotics (WHO, 2021).

The implications are staggering:

- Increased mortality: AMR causes at least 1.27 million deaths annually, with projections of 10 million per year by 2050 if trends continue (Murray et al., 2022).
- Longer, costlier treatments: Resistant infections require prolonged hospital stays, expensive last-line drugs (like vancomycin and colistin), and higher healthcare costs—estimated to reach $100 trillion globally by 2050 (O'Neill, 2016).
- Collapse of modern medicine: Routine procedures (C-sections, joint replacements) and treatments (chemotherapy, organ transplants) rely on effective antibiotics to prevent infections. Without them, these interventions become high-risk.

Beyond AMR, antibiotic abuse disrupts the human microbiome, increasing susceptibility to opportunistic infections like *Clostridioides difficile* colitis. Unnecessary antibiotic exposure also raises the risk of severe allergic reactions and side effects, while environmental contamination with antibiotic residues fuels further resistance in ecosystems (Bengtsson-Palme et al., 2018). Combating antibiotic abuse requires a global, multisectoral "One Health" strategy, integrating human, animal, and environmental health policies. Key interventions include:

*Antibiotic Stewardship Programs (ASPs)* – Promoting judicious prescribing in hospitals, with guidelines to avoid unnecessary use (Dyar et al., 2017).

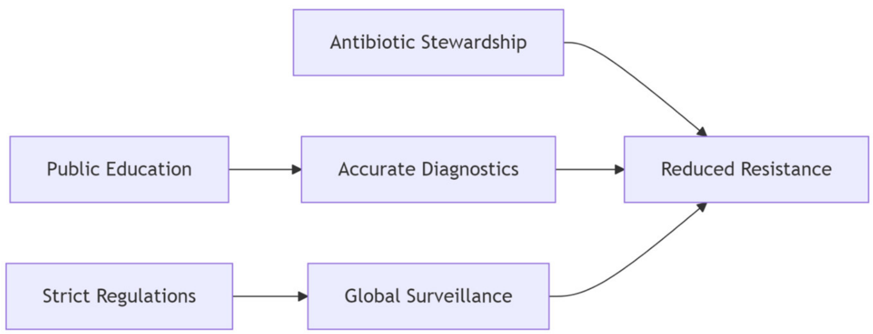
*Publi Awareness Campaigns* – Educating patients and farmers on proper antibiotic use and AMR risks (WHO's "Antibiotics: Handle with Care").

*Stricter Regulations* – Enforcing prescription-only access in human medicine and banning non-therapeutic agricultural use (EU's 2022 farm antibiotic ban).
*Rapid Diagnostics* – Investing in point-of-care tests to distinguish bacterial vs. viral infections (e.g., CRP testing).
*Infection Prevention* – Improving hygiene in hospitals and farms to reduce antibiotic reliance.
*New Drug Development* – Incentivizing novel antibiotics, alternatives (phage therapy), and vaccines to reduce dependence on existing drugs.

**Mechanism of Action: How Antibiotic Abuse Drives Resistance (with Diagram Description)**

Antibiotic drug abuse doesn't have a single pharmacological "mechanism of action" like a drug targeting a bacterium. Instead, it refers to misuse patterns that create powerful selective pressure, driving the evolution and spread of antimicrobial resistance (AMR) through fundamental biological mechanisms. Here's how it works:

**Core Biological Mechanism: Natural Selection Amplified by Misuse**




1. **Pre-Existing Variation:** Within any large bacterial population, there exists natural genetic variation. A tiny subset of bacteria may randomly possess or acquire mutations or genes (e.g., via plasmids) that confer resistance to a specific antibiotic (e.g., producing enzymes that break down the drug, altering the drug's target site, or pumping the drug out).
2. **Selective Pressure (The Abuse):** When antibiotics are used:
   - **Appropriately:** A sufficient dose for the correct duration against susceptible bacteria typically eradicates the entire population, including any pre-existing resistant mutants, before they can multiply significantly.
   - **Abusively (Underdosing/Incomplete Course):** The antibiotic concentration may be too low (sub-lethal) or the exposure time too short. This kills susceptible bacteria but *fails to kill* the small number of pre-existing resistant bacteria.
   - **Abusively (Overuse/Unnecessary Use):** Exposing large bacterial populations (human pathogens, commensals, environmental bacteria, animal microbiomes) to antibiotics unnecessarily creates vast opportunities for selection. Even correct dosing in an *unnecessary* situation selects for resistance in non-target bacteria.
3. **Selection & Amplification:** The resistant bacteria, now facing little competition from the killed susceptible bacteria, survive and **proliferate rapidly**. They become the dominant strain within that niche (e.g., a patient's gut, a wound, a farm animal).
4. **Spread:** Resistant bacteria can spread:
   - **Directly:** Between people (contact, droplets), animals, or from animals/environment to people.
   - **Via Resistance Genes:** Crucially, resistance genes (often located on mobile genetic elements like plasmids) can **horizontally transfer** between different bacterial species, even unrelated ones, through conjugation, transformation, or transduction. This rapidly disseminates resistance beyond the original bacterial strain and drug type (leading to MDR).

**How Specific Abuse Types Trigger This Mechanism:**

- **Incomplete Courses:** Directly creates sub-lethal antibiotic levels, selecting for resistant survivors.
- **Sub-Therapeutic Dosing (Human/Animal):** Maintains constant low-level antibiotic pressure, a powerful selector for resistance.

- **Overprescription for Viral Infections:** Unnecessarily exposes the patient's diverse bacterial flora (commensals and potential pathogens) to antibiotics, selecting for resistance in *any* bacteria present.
- **Agricultural Prophylaxis/Growth Promotion:** Involves long-term, low-dose antibiotics given to entire herds/flocks. This creates massive, continuous selective pressure within animal microbiomes and their environment, generating huge reservoirs of resistant bacteria and genes that can spread.
- **Self-Medication/Inappropriate Choice:** Often involves incorrect drug, dose, or duration, leading to ineffective treatment and selection.

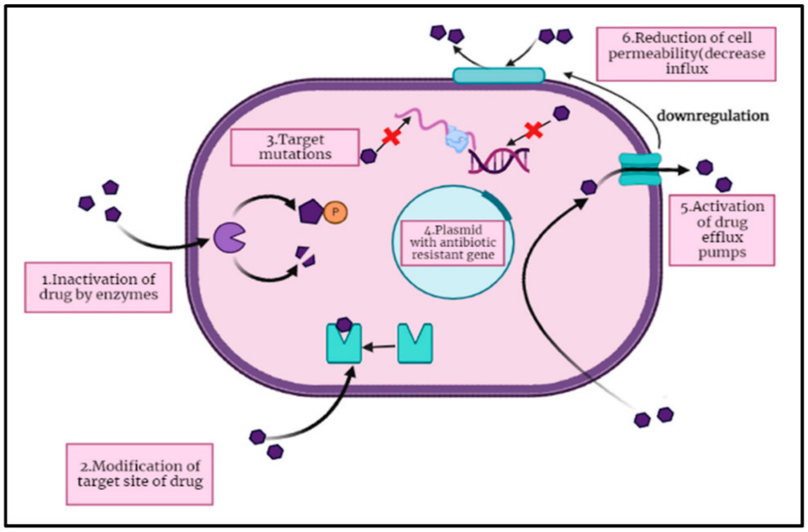



**Fig 1: The Cycle of Antibiotic Abuse Driving Resistance**

The Vicious Cycle: The diagram shows how different types of abuse (top) create selective pressure. This pressure acts on bacterial populations, eliminating susceptible bacteria and allowing resistant ones to flourish and acquire further resistance (middle). The outcome (bottom) is the emergence and spread of highly resistant bacteria, leading to treatment failures. This failure can sometimes paradoxically increase pressure to use (or misuse) other antibiotics, potentially fueling the cycle further, highlighting the critical need for stewardship and prevention.

## CONCLUSION

The "mechanism" of antibiotic abuse is fundamentally the artificial intensification of natural selection. By creating widespread, often sub-optimal, antibiotic exposure through misuse in humans and animals, we provide a massive survival advantage to resistant bacterial mutants and those carrying resistance genes. This selects for their dominance and enables the rapid horizontal spread of resistance traits, rendering our most vital antimicrobial weapons increasingly ineffective. Breaking this cycle requires eliminating the selective pressure at its source: the abuse itself.

## REFERENCES


1. WHO (2021). *Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report*. WHO
2. O'Neill, J. (2016). *Tackling Drug-Resistant Infections Globally*. Review on AMR
3. CDC (2019). *Antibiotic Resistance Threats in the United States*. CDC
4. UN Interagency Coordination Group (2019). *No Time to Wait: Securing the Future from Drug-Resistant Infections*. WHO
5. Fleming-Dutra, K.E. et al. (2016). *Prevalence of Inappropriate Antibiotic Prescriptions in the US*. JAMA, 315(17):1864–1873. DOI:10.1001/jama.2016.4151
6. Goossens, H. et al. (2005). *Outpatient Antibiotic Use in Europe & Resistance*. Lancet, 365(9459):579–587. DOI:10.1016/S0140-6736(05)17907-0
7. Klein, E.Y. et al. (2018). *Global Increase in Antibiotic Consumption 2000–2015*. PNAS, 115(15):E3463–E3470. DOI:10.1073/pnas.1717295115

8. Llor, C. & Bjerrum, L. (2014). *Antimicrobial Resistance: Risk of Antibiotic Overuse in Primary Care*. Br J Gen Pract, 64(629):604–605. DOI:10.3399/bjgp14X682561
9. Van Boeckel, T.P. et al. (2015). *Global Trends in Antimicrobial Use in Food Animals*. PNAS, 112(18):5649–5654. DOI:10.1073/pnas.1503141112
10. Tang, K.L. et al. (2017). *Restricting the Use of Antibiotics in Food Animals*. PLoS Biol, 15(11):e2002261. DOI:10.1371/journal.pbio.2002261
11. WHO (2017). *WHO Guidelines on Use of Medically Important Antimicrobials in Food-Producing Animals*. WHO
12. Davies, J. & Davies, D. (2010). *Origins and Evolution of Antibiotic Resistance*. Microbiol Mol Biol Rev, 74(3):417–433. DOI:10.1128/MMBR.00016-10
13. Blair, J.M.A. et al. (2015). *Molecular Mechanisms of Antibiotic Resistance*. Nat Rev Microbiol, 13:42–51. DOI:10.1038/nrmicro3380
14. Barlam, T.F. et al. (2016). *IDSA/SHEA Guidelines for Antibiotic Stewardship*. Clin Infect Dis, 62(10):e51–e77. DOI:10.1093/cid/ciw118
15. Davey, P. et al. (2017). *Interventions to Improve Antibiotic Prescribing*. Cochrane Database Syst Rev, 2:CD003543. DOI:10.1002/14651858.CD003543.pub4
16. Laxminarayan, R. et al. (2013). *Antibiotic Resistance—Need for Global Solutions*. Lancet Infect Dis, 13(12):1057–1098.
17. Ventola, C.L. (2015). *The Antibiotic Resistance Crisis*. P T, 40(4):277–283. PMC
18. Charani, E. et al. (2011). *Behavior Change Strategies to Influence Antimicrobial Prescribing*. Clin Infect Dis, 53(7):651–662.
19. Spellberg, B. et al. (2013). *The Future of Antibiotics and Resistance*. N Engl J Med, 368(4):299–302.
20. Carlet, J. et al. (2012). *Ready for a World Without Antibiotics?*. Lancet Infect Dis, 12(11):832–841.
21. Costelloe, C. et al. (2010). *Effect of Antibiotic Prescribing on Resistance in Individuals*. BMJ, 340:c2096. DOI:10.1136/bmj.c2096
22. Michael, C.A. et al. (2014). *Antibiotic Resistance*. J Pharm Pract Res, 44(4):295–300.
23. Teillant, A. et al. (2015). *Potential Burden of Antibiotic Resistance*. Lancet Infect Dis, 15(12):1420–1421.
24. Holmes, A.H. et al. (2016). *Understanding the Mechanisms of Antibiotic Resistance*. Science, 352(6282):aaf3941.
25. Collignon, P. et al. (2018). *Antibiotic Resistance: One Health*. Microbiol Aust, 39(3):116–119.
26. Årdal, C. et al. (2020). *DRIVE-AB Report: Revitalizing the Antibiotic Pipeline*. DRIVE-AB
27. Gelband, H. et al. (2015). *The State of the World's Antibiotics*. CDDEP. CDDEP
28. ECDC/EMEA (2009). *Joint Technical Report: Antimicrobial Resistance*. EMA
29. FAO/OIE/WHO (2020). *Monitoring Global Progress on AMR*. Tripartite AMR Report
30. The Lancet (2022). *Global Burden of Bacterial Antimicrobial Resistance*. Lancet, 399(10325):629–655. DOI:10.1016/S0140-6736(21)02724-0