International Journal of Pharmaceutical research and Applications
Volume 11, Issue 2, Mar-Apr 2026, pp:737-741 www.ijprajournal.com ISSN: 2456-4494

Antimicrobial Resistance: A Global Threat

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Date of Submission: 01-04-2026 Date of Acceptance: 11-04-2026

Abstract
Antimicrobial resistance (AMR) is a serious and growing global public health concern that occurs when microorganisms such as bacteria, viruses, fungi, and parasites develop the ability to survive exposure to antimicrobial drugs that were previously effective against them. As a result, standard treatments become less effective or fail completely, leading to persistent infections, increased risk of disease spread, prolonged illness, higher mortality rates, and a significant rise in healthcare costs. AMR threatens the successful prevention and treatment of a wide range of
infectious diseases and undermines many advances in modern medicine.The development and spread of antimicrobial resistance are primarily driven by irrational and excessive use of antimicrobial agents in human medicine, veterinary practice, and agriculture. Other contributing factors include poor infection prevention and control measures, inadequate sanitation, lack of awareness among healthcare providers and patients, self-medication, incomplete treatment courses, and the slow pace of development of new antimicrobial drugs. The emergence of multidrug-resistant (MDR) organisms has further complicated the management of infectious diseases, making treatment more difficult and expensive. AMR poses a major challenge to global health systems by increasing the burden of infectious diseases and limiting therapeutic options. It also threatens procedures that rely on effective antimicrobials, such as surgery, chemotherapy, and organ transplantation. Effective strategies to combat AMR include rational use of antibiotics, antimicrobial stewardship programs, improved infection control practices, surveillance of resistance patterns, public health education, and the development of new antimicrobial agents. Addressing AMR requires coordinated action at the global, national, and local levels to preserve health

Keywords: Drug resistance, Antibiotics, multidrug-resistant, Anti-microbials, Sepsis

I. Introduction

Antimicrobial resistance occurs when bacteria, viruses, fungi, and parasites change over time and no longer respond to medicines, making infections persist in the body and increasing the risk of spread to others [1]. Antimicrobials are essential for treating infections and enabling modern medical procedures such as surgery, cancer chemotherapy, and organ transplantation.

However, increasing resistance has become a major threat to global health, food security, and development. AMR has now emerged as one of the greatest global concerns in the 21st century due to the rapid growth of infection rates and the lack of new antimicrobial medications being introduced to combat resistance [2]. The World Health Organization (WHO) has declared AMR as one of the greatest threats to global public health [1]. This issue is often called the “silent
pandemic” [4].

Current scenario of antimicrobial resistance

Antimicrobial resistance is a serious and rapidly growing global health problem in which microorganisms become resistant to commonly used antimicrobial drugs. It results in treatment failure, increased morbidity and mortality, prolonged hospital stays, and higher healthcare costs. AMR is mainly driven by irrational use of antibiotics, poor infection control practices, and limited development of new antimicrobials. Without effective interventions, AMR is projected to cause millions of deaths annually by 2050, particularly in developing countries like India [3].

Antimicrobial resistance burden in India

In 2019, an estimated 230,000 deaths in India were associated with AMR. In 2021, the observed deaths increased to approximately 270,000.
By 2050, projected deaths due to AMR in India could range from 1 to 1.3 million annually. AMR is a significant global health threat, making infections harder to treat and increasing the risk of prolonged illness and death [3].

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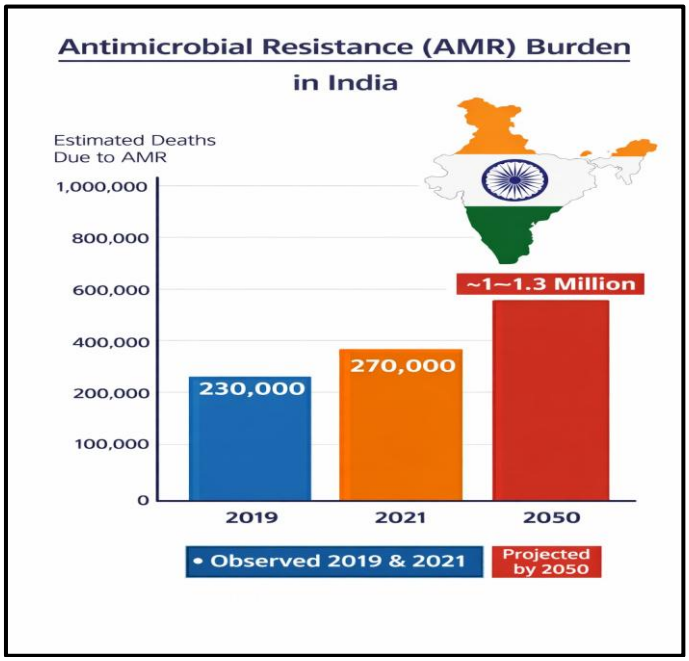

Global burden of AMR

In 2019, 1.27 million deaths were directly attributable to AMR, and 4.95 million deaths were associated with AMR globally [12]. In 2021, AMR was associated with 4.71 million deaths worldwide [12].
By 2050, forecasts predict 1.91 million deaths directly attributable to AMR and 8.22 million associated deaths [12].

AMR Challenges

AMR is a complex issue with significant implications for individuals and healthcare systems worldwide [5]. Nations globally adopted the Global Action Plan (GAP) on AMR at the 2015 World Health Assembly and pledged to develop National Action Plans (NAPs) using a One
Health approach [6]. WHO initiated the Global AMR Surveillance System (GLASS) in 2015 to monitor resistance patterns and antimicrobial consumption [7].
In 2017, India released its National Action Plan on AMR to improve awareness, surveillance, infection control, research, and collaboration [8]. Several states have developed State Action Plans aligned with WHO's GAP framework [8].
General physicians contribute significantly to antibiotic prescribing in India, highlighting the need for evidence-based guidelines and strengthened surveillance systems [9]. Integration of the One Health approach into primary healthcare is essential, especially in low- and middle-income countries like India [9].

Future Forecast of Antimicrobial Resistance

WHO identifies AMR as one of the top global public health threats of the 21st century [1]. If current trends continue, AMR may cause up to 10 million deaths annually by 2050 [3].
Resistant infections may surpass cancer and diabetes as leading causes of death [3]. Common infections such as pneumonia, tuberculosis, urinary tract infections, and sepsis may become untreatable [1].

Impact on Medical Procedures :
AMR threatens surgery, organ transplantation, cancer chemotherapy, neonatal care, and intensive care units due to infection risk [1]

Economic Burden :
WHO and the World Bank predict trillions of dollars in economic losses by 2050 due to AMR, increased healthcare costs, and productivity loss [10].

Impact of Agriculture :

Misuse of antibiotics in animals spreads resistance and threatens food security [6].

Sustainable Development Goals:
AMR can negatively impact SDGs including health,

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poverty reduction, and economic growth [11].

Global health security :
Resistant pathogens can spread via travel, trade, and environment, increasing pandemic risk [1].

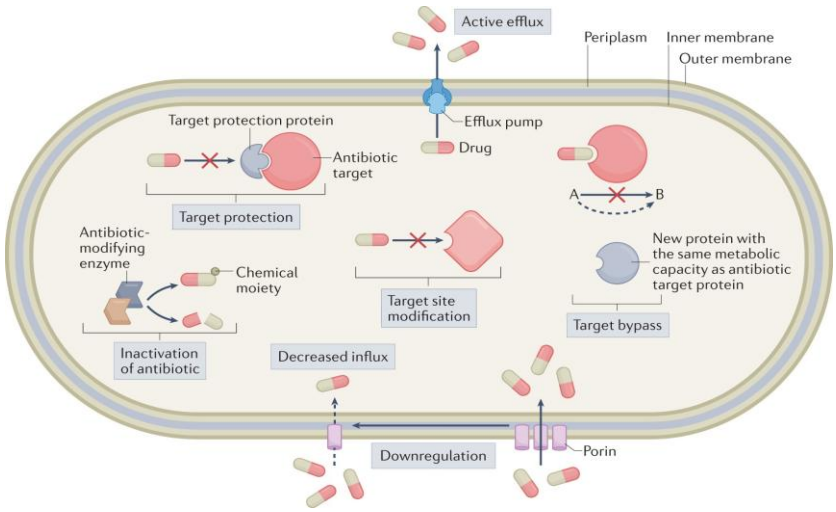
Key Resistant Pathogens

Methicillin-resistant Staphylococcus aureus (MRSA), multidrug-resistant tuberculosis (MDR-TB), carbapenem-resistant Enterobacterales (CRE), and drug-resistant Acinetobacter,
Pseudomonas, Salmonella, Shigella, and Neisseria gonorrhoeae are major global threats [13]. WHO priority pathogen lists highlight these organisms as critical public health threats [14].

Why resistance is a concern:

- When microorganisms become resistant to antimicrobials standard treatment are often ineffective,and in some cases no drugs provide effective therapy consequently, treatments fail.
- Increased mortality due to resistance.
- Resistant microbes may spread in the community.
- Low level resistance can go undetected.
- It threatens to return to pre antibiotic era[1].

Mechanism of antimicrobial resistance :



Some microorganisms may born resistant, some achieve resistance by mutation.

Intrinsic Resistance:-

Innate ability of a microbial agent to resist the activity of a particular antimicrobial agent through inherent structural or functional characteristics. allowing tolerance to a particular drug or antimicrobial agent[15].

Limiting uptake of a drug

Antimicrobial compounds almost always require access into the bacterial cell to reach their target site, where they can interfere with the normal function of the bacterial organism.
Porin channels are the passageways by which these antibiotics would normally cross the bacterial outer membrane of gram-negative bacteria
Some bacteria protect themselves by prohibiting these antimicrobial compounds from entering their cell walls.

Modifications of drug target

Modification of drug target is a mechanism of antimicrobial resistance in which microorganisms alter the structure of drug binding sites, reducing drug affinity and effectiveness.

Inactivation of drug

Inactivation of drug is a mechanism of antimicrobial resistance in which bacteria produce enzymes that destroy or chemically modify antibiotics.

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Active efflux of drug

Active efflux of drug is a mechanism of antimicrobial resistance in which bacteria expel antibiotics from the cell through energy-dependent efflux pumps. This decreases intracellular drug concentration and prevents the drug from reaching its target. Efflux-mediated resistance is commonly seen with tetracyclines, macrolides, fluoroquinolones, and chloramphenicol.

Multidrug efflux pumps contribute to multidrug resistance in bacteria[15].

Acquired resistance:-

This type of resistance results from changes in the bacterial genome. Acquired resistance is driven by two genetic processes in the bacteria:- Resistance may be developed by mutation and selection.

It may be developed by transfer of plasmids.

Mutation

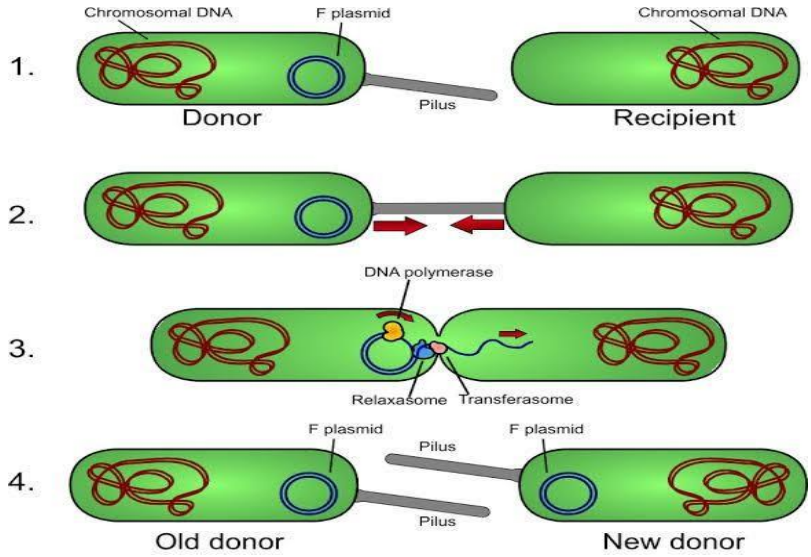
A mutation is a spontaneous change in the DNA sequence that may lead to change in the trait for which it coded.

Any change in a single base pair may lead to corresponding change in one or more of the corresponding amino acids, which can then change the cell structure and consequently affect the affinity or effectiveness activity of related antimicrobials.

Transfer of plasmid

Horizontal gene transfer, or the process of swapping genetic material between neighbouring bacteria, is another means by which resistance can be acquired.

Many of the antibiotic resistance genes are carried on plasmids, transposons, or integrons that act as vectors to transfer genes to other similar bacterial species[15].



Causes of antimicrobial resistance

- Misuse and overuse of Antibiotics :

Using antibiotics when not needed, such as for viral infections [1,5].

- Incomplete Treatment :

Not finishing the prescribed antibiotic course allows some microbes to survive and become resistant[5].

- Self-Medication :

Taking antibiotics without a prescription or medical guidance[9].

- Poor Infection Control practices :

Lack of proper hygiene, sanitation, and hospital infection control practices[6,13].

- Lack of development of New antibiotic :

Slow discovery of new antimicrobials leads to limited treatment options[3,10].

- Incorrect Dose or Inappropriate Drug Selection :

Using the wrong antibiotic or inadequate dose promotes resistance[5].

Prevention and Control Strategies

1 Antimicrobial Stewardship :
Rational prescribing of antibiotics
Guidelines and prescription monitoring 2 Infection Prevention :
Hand hygiene Vaccination
Hospital infection control programs 3 Public

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Awareness :
Education on antibiotic use
4 Research and Development ; Development of new antibiotics
Alternative therapies (phage therapy, vaccines) 5 One Health Approach :
Integrating human, animal, and environmental health strategies[1,6].

II. Conclusion

Antimicrobial resistance is a serious global health challenge that threatens modern medical practice. Rational use of antibiotics, strict infection control, public education, and continuous research are essential to combat AMR. Pharmacists and healthcare professionals play a vital role in preventing antimicrobial resistance and ensuring effective therapy.

References

[1]. World Health Organization. Antimicrobial resistance. WHO Fact Sheet; 2023.
[2]. Laxminarayan R, et al. Antibiotic resistance—the need for global solutions. Lancet Infect Dis. 2013;13(12):1057–1098.
[3]. O'Neill J. Tackling Drug-Resistant Infections Globally: Final Report and Recommendations. Review on Antimicrobial Resistance; 2016.
[4]. Murray CJL, et al. Global burden of bacterial antimicrobial resistance. Lancet. 2022;399(10325):629–655.
[5]. Ventola CL. The antibiotic resistance crisis. Pharmacy and Therapeutics. 2015;40(4):277–283.
[6]. WHO, FAO, OIE. Global Action Plan on Antimicrobial Resistance. Geneva: WHO; 2015.
[7]. World Health Organization. GLASS Report 2023. Geneva: WHO.
[8]. Ministry of Health and Family Welfare, India. National Action Plan on AMR 2017–2021. New Delhi: Government of India.
[9]. Kakkar M, et al. Antibiotic resistance in India: Drivers and opportunities. BMJ. 2017;358:j3545.
[10]. World Bank. Drug-resistant infections: A threat to global economic stability. Washington DC; 2017.
[11]. United Nations. Sustainable Development Goals. UN; 2015.
[12]. Global Research on AMR Collaborators. Global mortality associated with bacterial AMR. Lancet. 2024.
[13]. Centers for Disease Control and Prevention. Antibiotic resistance threats report. CDC; 2019.
[14]. World Health Organization. WHO priority pathogens list. Geneva: WHO; 2024.
[15]. Katzung BG. Basic and Clinical Pharmacology. 15th ed. McGraw Hill; 2021.