ISSN: 2320-7159
IJMR
INTERNATIONAL JOURNAL OF MEDICAL RESEARCH

PERSPECTIVE

Antimicrobial Resistance: A Silent Pandemic Threat

Gaurishanker Pashabhai Shrimali[1]

[1]Department of Microbiology, GMERS, Gandhinagar, Gujarat, India

Gaurishanker Pashabhai Shrimali (Email: gshrimali2016@gmail.com)

DOI: https://doi.org/10.55489/ijmr.1301202578

Citation: Shrimali GP. Antimicrobial Resistance: A Silent Pandemic Threat. Intl J Med Res 2025;13(1):14-17.DOI: 10.55489/ijmr.1301202578

Received: November 11, 2024
Accepted: November 26, 2024
Published: January 01, 2025

Funding: Non-Declared.

Conflict of interests: The authors have declared that no conflict of interests exists.

Publisher: Medsci Publications, India

ABSTRACT

Antimicrobial resistance (AMR) poses a formidable threat to global health, often termed a "silent pandemic" due to its insidious spread and devastating impact. This perspective examines the origins, scope, implications, and potential solutions to AMR, emphasizing its urgency. Driven by overuse of antimicrobials in medicine and agriculture, inadequate infection control, and limited diagnostics, AMR caused 1.27 million deaths in 2019, with projections of 10 million annual deaths by 2050. Gram-negative bacteria, such as *Escherichia coli* and *Klebsiella pneumoniae*, increasingly resist last-resort drugs, complicating treatments and routine procedures. Economically, AMR could cost US$1 trillion in healthcare and trillions in GDP losses by 2050. Low- and middle-income countries face disproportionate burdens, exacerbating global inequities. Solutions include antimicrobial stewardship, incentivizing new drug development via models like the PASTEUR Act, and enhancing global surveillance through WHO's GLASS. This article underscores AMR's One Health nature, linking human, animal, and environmental health, and calls for urgent, coordinated action to integrate AMR into broader health agendas. Biomedical communities must lead in policy advocacy and innovation to avert a crisis that threatens decades of medical progress.

Key words: Antimicrobial resistance, Silent pandemic, Antibiotic misuse, One Health, Global health, Stewardship

INTRODUCTION

In an era dominated by headlines of viral pandemics and climate crises, a more insidious threat lurks in the shadows of global health: antimicrobial resistance (AMR). Often dubbed the "silent pandemic," AMR occurs when bacteria, viruses, fungi, and parasites evolve mechanisms to withstand the drugs designed to eradicate them, rendering standard treatments ineffective [1]. This phenomenon is not a distant hypothetical; it is already claiming millions of lives annually and poised to escalate into one of the leading causes of death worldwide. According to recent estimates, bacterial AMR was directly responsible for 1.27 million deaths globally in 2019, with projections indicating that it could cause 10 million deaths annually by 2050 if unchecked [2]. Unlike acute outbreaks, AMR spreads quietly through hospitals, communities, and food chains, amplifying the burden on healthcare systems and economies. This perspective explores the origins, current landscape, implications, and potential solutions to AMR, emphasizing the urgent need for coordinated global action.

THE GENESIS OF RESISTANCE: CAUSES AND MECHANISMS

AMR is a natural evolutionary process accelerated by human activities. Microorganisms develop resistance through genetic mutations or by acquiring resistance genes from other microbes via horizontal gene transfer [3]. However, the primary drivers are anthropogenic. Overuse and misuse of antimicrobials in human medicine-such as prescribing antibiotics for viral infections-play a central role [4]. In agriculture, antibiotics are routinely used for growth promotion and disease prevention in livestock, contributing to resistant strains that transfer to humans via the food chain [5]. Poor infection prevention and control in healthcare settings, inadequate sanitation, and the global spread of counterfeit drugs further exacerbate the issue [4].

Recent studies highlight how these factors interplay. For instance, the COVID-19 pandemic intensified AMR by increasing antibiotic prescriptions for secondary bacterial infections, even when unnecessary, leading to a surge in resistant pathogens in hospitals [6]. The World Health Organization (WHO) reports that essential antibiotics like third-generation cephalosporins and fluoroquinolones are losing efficacy against common infections such as *Escherichia coli* and *Klebsiella pneumoniae* [1]. In low- and middle-income countries (LMICs), where access to diagnostics is limited, empirical antibiotic use is rampant, fueling resistance [7]. A 2022 Lancet study analyzing data from 2019 underscores that Gram-negative bacteria, particularly those resistant to last-resort drugs like carbapenems, are on the rise, driven by these multifaceted causes [2].

THE CURRENT LANDSCAPE: A GROWING CRISIS

The scale of AMR is staggering. In 2019, AMR was associated with 4.95 million deaths worldwide, including 1.27 million directly attributable to resistant infections [2]. Projections from the Global Research on Antimicrobial Resistance (GRAM) project forecast that by 2050, AMR could lead to significant mortality increases, particularly in Sub-Saharan Africa and South Asia, where young children and the elderly are most vulnerable [8]. The U.S. Centers for Disease Control and Prevention (CDC) notes that AMR kills at least 1.27 million people annually, with resistant fungi like *Candida auris* emerging as new threats [9].

The 2024 WHO Bacterial Priority Pathogens List identifies critical threats, including *Acinetobacter baumannii* and *Pseudomonas aeruginosa*, which show alarming resistance rates to multiple drug classes [10]. In oncology, AMR complicates cancer care, where immunocompromised patients face heightened risks from resistant infections during chemotherapy or surgery [11]. The silent nature of this pandemic lies in its gradual erosion of medical advancements: routine procedures like joint replacements or cesarean sections could become life-threatening without effective antimicrobials.

IMPLICATIONS: HEALTH, ECONOMIC, AND SOCIETAL TOLL

The ramifications of AMR extend beyond mortality. Health-wise, it prolongs illnesses, increases hospitalization rates, and strains resources. In 2019, resistant infections led to

nearly 5 million associated deaths, undermining progress toward universal health coverage (UHC) [2]. Economically, AMR imposes a massive burden. The World Bank estimates additional healthcare costs could reach US$1 trillion by 2050, with annual GDP losses between US$1 trillion and US$3.4 trillion [12]. A 2019 analysis estimated that hospital costs associated with antibiotic-resistant bacteria (ABR) neared US$700 billion globally, with productivity losses exceeding US$193 billion [13].

Societally, AMR exacerbates inequalities. LMICs, with limited access to second-line drugs, face disproportionate impacts, potentially reversing gains in child mortality and infectious disease control [14]. In agriculture, resistant pathogens threaten food security, with significant economic impacts on livestock production [14]. This interconnected web highlights AMR as a One Health issue, linking human, animal, and environmental health.

PATHWAYS FORWARD: SOLUTIONS & POLICY RECOMMENDATIONS

Addressing AMR requires multifaceted strategies. Antimicrobial stewardship programs-promoting judicious use through education and guidelines-are foundational [15]. The U.S. National Action Plan for Combating Antibiotic-Resistant Bacteria (2020-2025) aims to reduce healthcare-associated resistant infections by 20% and community-acquired ones by 10% through improved prescribing and surveillance [16]. Globally, the WHO's Global Action Plan emphasizes surveillance, infection prevention, and equitable access to antimicrobials [4].

Innovation is critical: incentivizing new antibiotic development via models like the PASTEUR Act could revitalize pipelines stagnant since the 1980s [17]. Public awareness campaigns, international collaboration, and investments in diagnostics and vaccines are essential [18]. The CDC's Antimicrobial Resistance Solutions Initiative focuses on prevention, better use, and slowing spread through rapid diagnostics and infection control [19]. Policy recommendations include phasing out non-therapeutic antibiotic use in agriculture and enhancing global data sharing via platforms like GLASS (Global Antimicrobial Resistance Surveillance System) [1].

CONCLUSION

AMR represents a silent yet escalating pandemic that threatens to undo decades of medical progress. With projections of 10 million annual deaths by 2050 and trillions in economic losses, the time for complacency has passed [2]. Biomedical communities must lead by advocating for evidence-based policies, fostering innovation, and promoting stewardship. By integrating AMR into broader health agendas, we can mitigate this threat and safeguard future generations. The silent pandemic demands a resounding response-now.

REFERENCES

1. World Health Organization. Antimicrobial resistance [Internet]. Geneva: WHO; 2024 [cited 2024 Sep 3]. Available from: https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance
2. Murray CJL, Ikuta KS, Sharara F, Swetschinski L, Robles Aguilar G, Gray A, et al. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. Lancet. 2022;399(10325):629-55. DOI: https://doi.org/10.1016/S0140-6736(21)02724-0 PMid:35065702
3. Munita JM, Arias CA. Mechanisms of antibiotic resistance. Microbiol Spectr. 2016;4(2):VMBF-0016-2015. DOI: https://doi.org/10.1128/microbiolspec.VMBF-0016-2015 PMid:27227291 PMCid:PMC4888801
4. World Health Organization. Global action plan on antimicrobial resistance [Internet]. Geneva: WHO; 2015 [cited 2024 Sep 3]. Available from: https://www.who.int/publications/i/item/9789241509763
5. Van Boeckel TP, Glennon EE, Chen D, Gilbert M, Robinson TP, Grenfell BT, et al. Reducing antimicrobial use in food animals. Science. 2017;357(6358):1350-2. DOI: https://doi.org/10.1126/science.aao1495 PMid:28963240 PMCid:PMC6510296
6. Langford BJ, Soucy JPR, Leung V, So M, Kwan ATH, Portnoff JS, et al. Antibiotic resistance associated with the COVID-19 pandemic: a systematic review and meta-analysis. Clin Microbiol Infect. 2023;29(3):302-9. DOI: https://doi.org/10.1016/j.cmi.2022.12.006 PMid:36509377 PMCid:PMC9733301
7. Iskandar K, Molinier L, Hallit S, Sartelli M, Hardcastle TC, Haque M, et al. Surveillance of antimicrobial resistance in low- and middle-income countries: a scattered picture. Antimicrob Resist Infect Control. 2021;10(1):49. DOI: https://doi.org/10.1186/s13756-021-00931-w PMid:33789754 PMCid:PMC8011122

8. Laxminarayan R, Van Boeckel T, Frost I, Kariuki S, Khan EA, Limmathurotsakul D, et al. The Lancet Infectious Diseases Commission on antimicrobial resistance: 6 years later. Lancet Infect Dis. 2020;20(4):e51-60. DOI: https://doi.org/10.1016/S1473-3099(20)30003-7 PMid:32059790

9. Centers for Disease Control and Prevention. Antibiotic resistance threats in the United States, 2019 [Internet]. Atlanta: CDC; 2019 [cited 2024 Sep 3]. Available from: https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf

10. World Health Organization. WHO bacterial priority pathogens list, 2024: bacterial pathogens of public health importance to guide research, development and strategies to prevent and control antimicrobial resistance [Internet]. Geneva: WHO; 2024 [cited 2024 Sep 5]. Available from: https://www.who.int/publications/i/item/9789240093461

11. Girmenia C, Viscoli C, Piciocchi A, Cudillo L, Botti S, Errico A, et al. Management of invasive fungal infections in cancer patients: an update. Clin Infect Dis. 2021;73(7):e1730-40.

12. World Bank. Drug-resistant infections: a threat to our economic future [Internet]. Washington, DC: World Bank; 2017 [cited 2024 Sep 8]. Available from: https://www.worldbank.org/en/topic/health/publication/drug-resistant-infections-a-threat-to-our-economic-future

13. Dadgostar P. Antimicrobial resistance: implications and costs. Infect Drug Resist. 2019;12:3903-10. DOI: https://doi.org/10.2147/IDR.S234610 PMid:31908502 PMCid:PMC6929930

14. Roope LSJ, Smith RD, Pouwels KB, Buchanan J, Abel L, Eibich P, et al. The challenge of antimicrobial resistance: what economics can contribute. Science. 2019;364(6435):eaau4679. DOI: https://doi.org/10.1126/science.aau4679 PMid:30948524

15. Dyar OJ, Huttner B, Schouten J, Pulcini C. Worldwide antibiotic resistance and stewardship: a call to action. Lancet Infect Dis. 2018;18(5):477-9.

16. U.S. Department of Health and Human Services. National action plan for combating antibiotic-resistant bacteria, 2020-2025 [Internet]. Washington, DC: HHS; 2020 [cited 2024 Sep 3]. Available from: https://aspe.hhs.gov/sites/default/files/migrated_legacy_files//196436/CARB-National-Action-Plan-2020-2025.pdf

17. Outterson K, Rex JH. Evaluating the PASTEUR Act: a proposed solution to the antibiotic innovation crisis. Health Aff (Millwood). 2021;40(4):554-61.

18. Laxminarayan R, Duse A, Wattal C, Zaidi AKM, Wertheim HFL, Sumpradit N, et al. Antibiotic resistance-the need for global solutions. Lancet Infect Dis. 2013;13(12):1057-98. DOI: https://doi.org/10.1016/S1473-3099(13)70318-9 PMid:24252483

19. Centers for Disease Control and Prevention. About antimicrobial resistance [Internet]. Atlanta: CDC; 2023 [cited 2024 Sep 3]. Available from: https://www.cdc.gov/antimicrobial-resistance/about/index.html