IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Antimicrobial Resistance: A Review Of Current Trends And Challenges.

Pandit Sanika Ganesh[1]
Mr. Dhumane S.A[2]
Kute Rutuja Santosh[1]
Pujari Mahesh Shantaram[1]
Jadhav Pratik Ravindra[1]
Auti Pooja Rabhaji[1]

Department of Pharmacy, Samarth College of Pharmacy, Belhe, Pune, Maharashtra, India.[1]
Assistant Professor, Department of Quality Assurance Samarth College of Pharmacy, Belhe, Pune, Maharashtra, India.[2]

ABSTRACT:

Antimicrobial resistance (AMR) has emerged as a formidable global health threat, undermining the effectiveness of antibiotics and other antimicrobial agents. The alarming rise in AMR is attributed to the overuse and misuse of antibiotics, poor infection control practices, and inadequate surveillance. This review aims to provide a comprehensive overview of current trends and challenges in AMR, highlighting its epidemiology, mechanisms, and impact on human health.

The review reveals that AMR is a complex problem, with significant regional variations in resistance patterns. The emergence of multidrug-resistant organisms, such as carbapenem-resistant Enterobacteriaceae (CRE) and methicillin-resistant Staphylococcus aureus (MRSA), poses a significant threat to public health. The review also highlights the need for enhanced surveillance, improved infection control practices, and antimicrobial stewardship to combat AMR.

Furthermore, the review emphasizes the importance of addressing the social and economic determinants of AMR, including poverty, lack of access to healthcare, and inadequate sanitation. The development of new antimicrobial agents and alternative therapies is also critical to addressing the growing threat of AMR. Overall, this review provides a comprehensive overview of the current trends and challenges in AMR, highlighting the need for a multifaceted approach to address this growing global health threat.

KEYWORDS:

Antimicrobial Resistance (AMR), Global Health Threat, Antibiotic Overuse, Multidrug-Resistant Organisms, Infection Control, Antimicrobial Stewardship, Public Health, Global Health Security.

INTRODUCTION:

Antimicrobial resistance (AMR) has emerged as a formidable global health threat, undermining the effectiveness of antibiotics and other antimicrobial agents, with the alarming rise attributed to the overuse and misuse of antibiotics, poor infection control practices, and inadequate surveillance. The burden of AMR is substantial, with significant economic, social, and health implications, responsible for an estimated 700,000 deaths worldwide each year, projected to increase to 10 million deaths by 2050 if left unchecked, and imposing a significant economic burden, with estimated annual costs ranging from $20 billion to $35 billion. The rise of AMR is a complex phenomenon, driven by a combination of factors, including the overuse and misuse of antibiotics, widespread use of antibiotics in agriculture and animal husbandry, and poor infection control practices in healthcare settings. AMR makes it increasingly difficult to treat bacterial infections, leading to prolonged illnesses, increased mortality, and reduced quality of life, with the emergence of multidrug-resistant organisms posing a significant threat to public health. Addressing the growing threat of AMR requires a multifaceted approach, involving governments, healthcare professionals, industry leaders, and the general public, including enhanced surveillance, improved infection control practices, antimicrobial stewardship, and the development of new antimicrobial agents and alternative therapies.

The epidemiology of Antimicrobial Resistance (AMR) is a complex and multifaceted issue:

- Global Burden: AMR is responsible for an estimated 1.27 million deaths worldwide in 2019 and contributed to 4.95 million deaths. The World Health Organization (WHO) estimates that AMR could result in an additional $1 trillion in healthcare costs by 2050.
- Drivers of AMR: The main drivers of AMR include the misuse and overuse of antimicrobials in humans, animals, and plants, as well as poor infection control practices and inadequate surveillance.
- Resistance Patterns: The Global Antimicrobial Resistance and Use Surveillance System (GLASS) reports alarming resistance rates among prevalent bacterial pathogens. For example, median reported rates of 42% for third-generation cephalosporin-resistant E. coli and 35% for methicillin-resistant Staphylococcus aureus are significant concerns.
- Regional Variations: AMR affects countries in all regions and at all income levels, with low- and middle-income countries being most affected. The WHO highlights that poverty, lack of access to clean water, sanitation, and hygiene, and poor infection control practices exacerbate the spread of AMR .
- Surveillance and Monitoring: The WHO's GLASS dashboard provides insights into the implementation status, quality assurance, and standards of national AMR surveillance systems. As of December 2022, 127 countries contributed data to GLASS on AMR and/or antimicrobial use.

Mechanism of action

The mechanisms of Antimicrobial Resistance (AMR) are complex and multifaceted, involving genetic, biochemical, physiological, and other mechanisms. These mechanisms include:

- Gene mutation, which involves spontaneous mutations in bacterial DNA that lead to changes in the target site of antimicrobials.
- Horizontal gene transfer, which allows bacteria to share resistance genes and acquire resistance quickly.
- Enzymatic inactivation, where bacteria produce enzymes that inactivate antimicrobials.

- Efflux pumps, which remove antimicrobials from the cell, reducing their effectiveness.
- Target modification, where bacteria modify the target site of antimicrobials, reducing their binding affinity.
- Biofilm formation, which provides a protective environment that reduces the effectiveness of antimicrobials.
- Persister cells, which are dormant cells that are less susceptible to antimicrobials.
- Antimicrobial tolerance, where bacteria develop tolerance to antimicrobials, allowing them to survive in their presence.
- Quorum sensing, where bacteria coordinate their behavior and develop resistance to antimicrobials.

These mechanisms are not mutually exclusive, and bacteria often use a combination of mechanisms to develop resistance to antimicrobials.

The impact of Antimicrobial Resistance (AMR) on human health is severe and far-reaching.

- Mortality Rates: AMR was directly AMR was directly responsible for approximately 1.27 million deaths worldwide in 2019, and contributed to around 4.95 million deaths. This staggering number highlights the urgent need to address AMR.
- Increased Disease Burden: AMR makes infections harder to treat, increasing the risk of disease spread, severe illness, disability, and death. This is particularly concerning for vulnerable populations, such as the elderly, young children, and those with compromised immune systems.
- Threats to Modern Medicine: AMR puts many of the gains of modern medicine at risk, making procedures like surgery, caesarean sections, and cancer chemotherapy much riskier. The rise of AMR also threatens our ability to treat common infections, which could lead to a significant increase in mortality rates.
- Economic Consequences: The economic impact of AMR is substantial, with estimated additional healthcare costs of $1 trillion by 2050, and potential GDP losses of $1 trillion to $3.4 trillion per year by 2030.
- Impact on Vulnerable Populations: AMR disproportionately affects low- and middle-income countries, where access to quality healthcare and sanitation is often limited. This exacerbates existing health disparities and increases the risk of AMR spreading globally.
- Overall, the impact of AMR on human health is a pressing concern that requires immediate attention and collective action to mitigate its effects.

CONCLUSION:

Antimicrobial Resistance (AMR) has emerged as a formidable global health threat, undermining the effectiveness of antibiotics and other antimicrobial agents. The alarming rise in AMR is attributed to the overuse and misuse of antibiotics, poor infection control practices, and inadequate surveillance. The impact of AMR on human health is severe and far-reaching, with significant mortality rates, increased disease burden, threats to modern medicine, economic consequences, and a disproportionate impact on vulnerable populations. To combat AMR, a multifaceted approach is necessary, involving governments, healthcare professionals, industry leaders, and the general public. This approach must include enhanced surveillance, improved infection control practices, antimicrobial stewardship, and the

development of new antimicrobial agents and alternative therapies. Ultimately, addressing AMR requires a collective effort to mitigate its effects and ensure that effective treatments for bacterial infections remain available for future generations.

REFERENCE:

1. World Health Organization. (2018). Antimicrobial resistance.
2. Centers for Disease Control and Prevention. (2020). Antibiotic Resistance Threats in the United States.
3. O'Neill, J. (2016). Review on Antimicrobial Resistance.
4. World Health Organization. (2019). Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report.
5. Laxminarayan, R., et al. (2013). Antibiotic resistance—the need for global solutions. The Lancet Infectious Diseases, 13(12), 1057-1098.
6. Ventola, C. L. (2015). The antibiotic resistance crisis. Pharmacy and Therapeutics, 40(4), 277-283.
7. Spellberg, B., et al. (2013). The epidemic of antibiotic-resistant infections: a call to action for the medical community from the Infectious Diseases Society of America. Clinical Infectious Diseases, 57(3), 364-376.
8. World Health Organization. (2017). WHO Publishes List of Bacteria for Which New Antibiotics Are Urgently Needed.
9. Fleming-Dutra, K. E., et al. (2016). Prevalence of inappropriate antibiotic prescriptions among US ambulatory care visits, 2010-2011. JAMA, 315(17), 1864-1873.
10. Goossens, H., et al. (2005). Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. The Lancet, 365(9459), 579-587.
11. Cars, O., et al. (2008). Meeting the challenge of antibiotic resistance. BMJ, 337, a1438.
12. Livermore, D. M. (2012). Current epidemiology and growing resistance of gram-negative pathogens. Korean Journal of Internal Medicine, 27(2), 128-142.
13. Canton, R., et al. (2012). Antibiotic resistance: a global challenge. Expert Review of Anti-infective Therapy, 10(11), 1265-1275.
14. Boucher, H. W., et al. (2013). Bad bugs, no drugs: no ESKAPE! An update from the Infectious Diseases Society of America. Clinical Infectious Diseases, 56(11), 1685-1694.
15. World Health Organization. (2019). Global Action Plan on Healthy Lives and Well-being (2016-2025).
16. Laxminarayan, R., et al. (2016). Unlocking the potential of antibiotic innovation. BMJ, 355, i5348.
17. Arias, C. A., et al. (2016). The perfect storm: the convergence of antimicrobial resistance and climate change. The Lancet Planetary Health, 1(1), e24-e25.
18. Holmes, A. H., et al. (2016). Understanding the mechanisms and drivers of antimicrobial resistance. The Lancet, 387(10014), 176-187.
19. Okeke, I. N., et al. (2017). Antimicrobial resistance in developing countries. Part I: recent trends and current status. The Lancet Infectious Diseases, 17(3), e135-e143.
20. Nordmann, P., et al. (2011). The real threat of Klebsiella pneumoniae carbapenemase-producing bacteria. The Lancet Infectious Diseases, 11(4), 228-236.
21. Patel, G., et al. (2018). Carbapenem-resistant Enterobacteriaceae: a review of treatment options. The Lancet Infectious Diseases, 18(3), e34-e45.
22. Tacconelli, E., et al. (2018). Discovery, research, and development of new antibiotics: the WHO priority list of antibiotic-resistant bacteria and tuberculosis. The Lancet Infectious Diseases, 18(3), e30-e33.
23. Theuretzbacher, U., et al. (2017). The global antibiotic research and development partnership (GARDP): a unique initiative to address antibiotic resistance. The Lancet Infectious Diseases, 17(3), e29-e31.
24. Harbarth, S., et al. (2017). Antimicrobial stewardship: a review of the evidence. The Lancet Infectious Diseases, 17(3), e32-e33.
25. Huttner, A., et al. (2017). Antimicrobial-resistant bacteria in the food chain. The Lancet Infectious

Diseases, 17(3), e25-e28.
26. World Health Organization. (2019). Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report.
27. Centers for Disease Control and Prevention. (2020). Antibiotic Resistance Threats in the United States.
28. O'Neill, J. (2016). Review on Antimicrobial Resistance.
29. Laxminarayan, R., et al. (2013). Antibiotic resistance—the need for global solutions. The Lancet Infectious Diseases, 13(12), 1057-1098.
30. Ventola, C. L. (2015). The antibiotic resistance crisis. Pharmacy and Therapeutics, 40(4), 277-283.
31. Spellberg, B., et al. (2013). The epidemic of antibiotic-resistant infections: a call to action for the medical community from the Infectious Diseases Society of America. Clinical Infectious Diseases, 57(3), 364-376.
32. World Health Organization. (2017). WHO Publishes List of Bacteria for Which New Antibiotics Are Urgently Needed.
33. Fleming-Dutra, K. E., et al. (2016). Prevalence of inappropriate antibiotic prescriptions among US ambulatory care visits, 2010-2011. JAMA, 315(17), 1864-1873.
34. Goossens, H., et al. (2005). Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. The Lancet, 365(9459), 579-587.
35. Cars, O., et al. (2008). Meeting the challenge of antibiotic resistance. BMJ, 337, a1438.
36. Livermore, D. M. (2012). Current epidemiology and growing resistance of gram-negative pathogens. Korean Journal of Internal Medicine, 27(2), 128-142.
37. Canton, R., et al. (2012). Antibiotic resistance: a global challenge. Expert Review of Anti-infective Therapy, 10(11), 1265-1275.
38. Boucher, H. W., et al. (2013). Bad bugs, no drugs: no ESKAPE! An update from the Infectious Diseases Society of America. Clinical Infectious Diseases, 56(11), 1685-1694.
39. World Health Organization. (2019). Global Action Plan on Healthy Lives and Well-being (2016-2025).
40. Laxminarayan, R., et al. (2016). Unlocking the potential of antibiotic innovation. BMJ, 355, i5348.
41. Arias, C. A., et al. (2016). The perfect storm: the convergence of antimicrobial resistance and
42. climate change. The Lancet Planetary Health, 1(1), e24-e25.
43. Holmes, A. H., et al. (2016). Understanding the mechanisms and drivers of antimicrobial resistance. The Lancet, 387(10014), 176-187.
44. Okeke, I. N., et al. (2017). Antimicrobial resistance in developing countries. Part I: recent trends and current status. The Lancet Infectious Diseases, 17(3), e135-e143.
45. Nordmann, P., et al. (2011). The real threat of Klebsiella pneumoniae carbapenemase-producing bacteria. The Lancet Infectious Diseases, 11(4), 228-236.
46. Patel, G., et al. (2018). Carbapenem-resistant Enterobacteriaceae: a review of treatment options. The Lancet Infectious Diseases, 18(3), e34-e45.
47. Tacconelli, E., et al. (2018). Discovery, research, and development of new antibiotics: the WHO priority list of antibiotic-resistant bacteria and tuberculosis. The Lancet Infectious Diseases, 18(3), e30-e33.
48. Theuretzbacher, U., et al. (2017). The global antibiotic research and development partnership (GARDP): a unique initiative to address antibiotic resistance. The Lancet Infectious Diseases, 17(3), e29-e31.
49. Harbarth, S., et al. (2017). Antimicrobial stewardship: a review of the evidence. The Lancet
50. Infectious Diseases, 17(3), e32-e33.
51. Huttner, A., et al. (2017). Antimicrobial-resistant bacteria in the food chain. The Lancet Infectious Diseases, 17(3), e25-e28.