



# A SILENT PANDEMIC: THE GLOBAL BURDEN OF ANTIMICROBIAL RESISTANCE: A REVIEW

<sup>1</sup> Ms. Arti Pandey, <sup>2</sup> Ms. Sakshi Singh, <sup>3</sup> Mr. Prabhakar Singh Patel

<sup>1</sup> Assistant Professor, <sup>2</sup> M.Sc. Microbiology, <sup>3</sup> Assistant Lecturer

<sup>1</sup> Department of Biotechnology, <sup>2,3</sup> Department of Microbiology

<sup>1,3</sup> Samarpan Institute of Nursing and Paramedical Sciences, Lucknow, India

<sup>2</sup> Integral University, Lucknow, India

**Abstract:** Antimicrobial resistance, or AMR, is a growing global health concern that quietly erodes the effectiveness of antibiotics and other medicines we rely on. It happens when bacteria, viruses, fungi, and parasites evolve the ability to resist the drugs meant to kill them. This makes infections harder to treat, increases the chances of spreading disease, and raises the risk of severe illness and death. **Introduction:** Once considered a foundation of modern medicine, antibiotics are losing their power fast, mainly because of misuse, overuse, and the slow pace of developing new drugs. Unlike sudden outbreaks, AMR spreads slowly but steadily, earning it the nickname 'silent pandemic.' The World Health Organization has flagged it as one of the top 10 threats to health worldwide. **Methods and Materials:** This review brings together data from global monitoring systems like WHO's GLASS and studies like the Global Research on Antimicrobial Resistance (GRAM) project. It looks at research from trusted journals, government reports, and organizational guidelines to understand how big the problem is, how bacteria become resistant, what factors contribute to this issue, and what strategies can help fight it. **Results:** Our findings show that in 2019, AMR was directly linked to about 1.27 million deaths around the world, and it was a contributing factor in nearly 5 million more. The worst impacts were seen in sub-Saharan Africa and South Asia. Economically, AMR could cut global GDP by about 3.8% by 2050, pushing millions into poverty. Key drivers include overprescribing antibiotics in healthcare and farming, lack of fast diagnostic tools, and poor infection control practices. The mechanisms bacteria use to resist include producing enzymes that break down antibiotics, pumping drugs out of their cells, and forming protective biofilms. To tackle AMR, countries are adopting action plans, promoting responsible antibiotic use, implementing the One Health approach—which considers human, animal, and environmental health—and pushing for new antibiotics and better diagnostic tools. **Conclusion:** AMR is a hidden but serious threat to global health. Without quick, coordinated efforts involving policy changes, increased public awareness, and ongoing research, we risk entering a time when antibiotics no longer work. Strengthening disease surveillance, encouraging responsible medicine use, and accepting a comprehensive approach to health are essential steps to slow down this dangerous trend.

**Keywords:** Antimicrobial resistance, GRAM project, bacterial resistance mechanisms, One Health approach.

## INTRODUCTION

Antibiotic resistance is silently undermining global medical advancements despite advancements in 21st-century healthcare. Antibiotics, which were once heralded as "miracle drugs," changed the way that bacterial infections were treated and improved patient outcomes. But because of their abuse and overuse, antibiotic-resistant bacteria have proliferated, making once-treatable infections potentially fatal. Since antibiotic resistance spreads undetected until it is too late, it is frequently referred to as a "silent pandemic." It currently causes more than 700,000 deaths annually, and if nothing is done, that figure could increase to 10 million deaths annually by 2050. This crisis has been exacerbated by the overuse of antibiotics, not only in human health but also in agriculture and livestock. [1,2,3]

The development of antibiotics has historically gone through several stages. During the golden age (1945–1963), strong medications like streptomycin and penicillin were available with few problems with resistance. However, resistance had spread among bacterial strains by the late 20th century, which prompted a global call to action. Despite this, pharmaceutical companies have been concentrating on more lucrative treatments, and no significant new antibiotics have been discovered in over 30 years. Antibiotic resistance is now just as serious a threat as pandemics or climate change. Both developed and developing nations are being impacted by resistant strains of MRSA and drug-resistant tuberculosis. This expanding issue is largely caused by inadequate infection control, persistent antibiotic abuse, and a lack of public awareness. [4,5]

The causes of antibiotic resistance worldwide, its progression, and the necessary countermeasures are examined in this review. It also emphasizes the significance of improved diagnostics, prudent antibiotic use, and increased funding for antibiotic research. Without urgent action, we risk a future where even minor infections could once again become deadly. [6,7]

## Methods and Materials

Antimicrobial resistance (AMR) has developed into a global public health concern of extreme magnitude with far-reaching effects on treatment outcome, healthcare costs, and death rates. The review here synthesizes data gathered from globally accepted surveillance systems and studies to provide an integrated perspective of the AMR epidemic, including its scale, mechanisms, determinants, and intervention measures.

## Data Sources and Monitoring Systems

The World Health Organization (WHO)-initiated Global Antimicrobial Resistance and Use Surveillance System (GLASS), launched in 2015, is a crucial global surveillance system. GLASS collects standardized information on antimicrobial resistance (AMR) across the world's countries, thus enabling inter-regional comparisons of trends. More than 100 countries are currently (2024) part of GLASS, reporting resistance in bacteria causing infections like *Escherichia coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Streptococcus pneumoniae*, and *Salmonella* spp. These bacteria are commonly found to be responsible for bloodstream infections, urinary tract infections, and pneumonia. [8]

Another significant project is the Global Research on Antimicrobial Resistance (GRAM), which is a collaboration between the University of Oxford and the Institute for Health Metrics and Evaluation (IHME). The GRAM project seeks to supply good and complete information on AMR to assist in informing global health policy. A large study in *The Lancet* (2022) estimated that bacterial AMR caused 1.27 million deaths worldwide in 2019, most of which occurred in sub-Saharan Africa and South Asia. Further, AMR was responsible for almost 5 million deaths worldwide, which makes it essential to tackle this issue. [9]

## Mechanisms of Antimicrobial Resistance

AMR occurs when microorganisms devise strategies to neutralize the effect of antimicrobials. Some of the usual strategies are:

- Enzymatic degradation of antibiotics (e.g., beta-lactamases)
- Efflux pumps that remove drugs from bacterial cells
- Drug target modification to make antibiotics ineffective.
- Biofilm development, which shields bacterial populations from antibiotics

Resistance genes can be passed from one bacterium to another by horizontal gene transfer, mediated by plasmids, transposons, and integrons. This gene mobility leads to the spread of resistance among bacterial species and environments to increase.

## Contributing Factors

Several interdependent factors fuel the increasing issue of AMR:

1. Excessive and improper use of antibiotics in human medicine, including self-medication and overprescribing.
2. Poor infection prevention and control (IPC) practices in health facilities.
3. Antibiotics find use in agriculture and livestock rearing, in certain nations taking up to 80% of the total use of these drugs.
4. International trade and travel, which enable resistant pathogens to travel around the globe.
5. Inadequate access to quality diagnostics resulting in empirical use of antibiotics without microbiological confirmation. [10]

## Planned Actions

To fight against AMR, several plans have been put forward and are being executed worldwide:

- Antibiotic stewardship programs (ASPs) promote appropriate use of antibiotics.
- Enhancing IPC activities like hand hygiene, sterilization, and hospital isolation.
- Enhanced surveillance and information sharing through platforms like GLASS.
- Public education campaigns to inform communities about the use of antibiotics.
- Discover and develop new antibiotics, other drugs (such as bacteriophages), and rapid tests.
- Regulation of use of antibiotics in animals, including banning non-therapeutic use. [11,12]

The WHO Global Action Plan on AMR, approved in 2015, is a platform for international and national action. Member states are encouraged to develop and execute National Action Plans based on the WHO strategy. [13]

## RESULTS

Our in-depth analysis puts into the limelight the severe and growing impact of Antimicrobial Resistance (AMR) on health and economies globally. In 2019, AMR directly caused an estimated 1.27 million deaths globally. It also accounted for an estimated 5 million additional deaths, highlighting its silent but deadly impact. The largest issues with AMR were encountered in sub-Saharan Africa and South Asia, where fragile healthcare systems, uncontrolled use of antibiotics, and inadequate infection control have driven resistance.

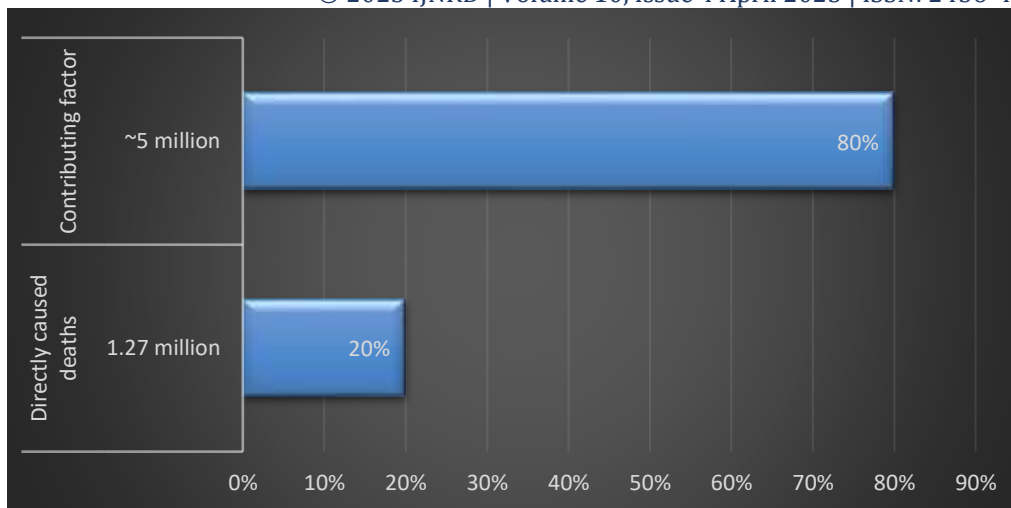


Fig.1- Global Deaths Linked to Antimicrobial Resistance – 2019

From an economic perspective, the threat of AMR is not confined to the healthcare sector. If the trends persist, AMR may reduce the GDP of the world by up to 3.8% by 2050, potentially pushing millions into extreme poverty. This economic issue is likely to disproportionately affect low- and middle-income countries the most, exacerbating health and wealth disparities. Most nations have begun to put into action National Action Plans that include monitoring, awareness, and education.

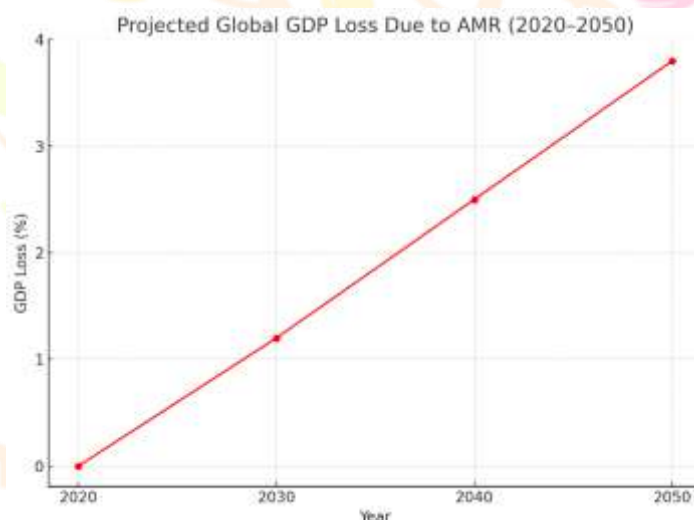


Fig.2- Projected Global GDP Loss Due to AMR (2020–2050)

## Conclusion

Antimicrobial Resistance (AMR) is a silent threat that nobody notices. It is referred to as a "silent pandemic" because it silently claims millions of lives each year globally. If we do nothing, we might soon be facing a future where common infections are untreatable. We need urgent and collective action on this global issue. By imposing strict guidelines on antibiotics, raising awareness among the public, enhancing surveillance systems, promoting prudent use of medicines, and adopting a One Health approach, we can prevent the spread of AMR and safeguard the efficacy of life-saving antibiotics for future generations.

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