Anti-microbial resistance

Empowering Future Generations: Cultivating Global Literacy and Enlightenment

Forum: WHO
Issue: Addressing the rise of Antimicrobial Resistance (AMR)
Student Officer: Ben Geertman
Position: Chair

Introduction

Antimicrobial Resistance (AMR) is one of the most significant public health challenges of the 21st century. It occurs when microorganisms—such as bacteria, fungi, viruses, and parasites—develop resistance to the drugs designed to kill or inhibit their growth. This phenomenon threatens the effectiveness of antibiotics, antivirals, and antifungals, rendering once-treatable infections more difficult, if not impossible, to cure. AMR can lead to longer hospital stays, more intensive care, and a higher risk of death, complicating medical procedures ranging from routine surgeries to cancer treatments.

Antimicrobial Resistance (AMR) poses not only a severe public health challenge but also a significant economic burden on global economies. The rising prevalence of drug-resistant infections leads to increased healthcare costs due to prolonged hospital stays, the need for more expensive second- and third-line treatments, and greater reliance on intensive care. According to estimates from the World Bank, AMR could cause a reduction in global GDP of up to 3.8% by 2050, with developing economies being disproportionately affected. The economic impact extends beyond healthcare, affecting productivity as prolonged illness and higher mortality rates reduce workforce participation. Additionally, industries reliant on antimicrobials, such as agriculture and livestock farming, may suffer from lower yields and increased costs due to restrictions on antibiotic use and the spread of resistant infections.

International organizations have classified AMR as a top-tier global health threat. The World Health Organization (WHO) has designated AMR as one of the top 10 global public health threats, warning that without urgent action, common infections could once again become lethal. The Centers for Disease Control and Prevention (CDC) in the United States has categorized AMR threats into urgent, serious, and concerning levels, highlighting pathogens such as carbapenem-resistant Enterobacterales (CRE) and drug-resistant Neisseria gonorrhoeae as critical threats. Similarly, the European Centre for Disease Prevention and Control (ECDC) and the United Nations have emphasized the need for immediate, coordinated action to prevent AMR from undermining modern medicine and economic stability.

Definition of Key Terms

Antimicrobial Resistance (AMR)

The ability of microorganisms to resist the effects of drugs that once killed them or inhibited their growth, making infections harder to treat.

definition from WHO:
Antimicrobial Resistance (AMR) occurs when bacteria, viruses, fungi and parasites no longer respond to antimicrobial medicines

Antimicrobials

A broad term for drugs, chemicals, or other substances used to kill or inhibit the growth of microorganisms, including antibiotics, antivirals, antifungals, and antiparasitics.

Antibiotics

A subclass of antimicrobials used to treat bacterial infections.

Superbugs

Microorganisms, particularly bacteria, have developed resistance to multiple antibiotics, making them harder to treat.

Selective Pressure

The environmental factors (such as the overuse of antibiotics) that promote the survival of resistant microorganisms.

Gene Transfer

The process by which bacteria exchange genetic material, including genes that confer resistance to antimicrobials.

Infection Control

Measures taken to prevent the spread of infections, including hand hygiene, isolation of patients, and sterilization of equipment, which play a role in preventing AMR.

One Health Approach

A holistic strategy that recognizes the interconnectedness of human health, animal health, and environmental health in addressing AMR.

Broad-Spectrum Antibiotics

Antibiotics that are effective against a wide range of bacteria, often used when the specific bacteria causing an infection is unknown.

Narrow-Spectrum Antibiotics

Antibiotics that target specific types of bacteria, generally preferred to reduce the risk of developing AMR.

Antimicrobial Stewardship

The coordinated efforts to optimize the use of antimicrobials in healthcare settings to prevent misuse and overuse.

Plasmid

A small DNA molecule within a cell that is separate from the chromosomal DNA and can carry genes for antibiotic resistance, contributing to AMR.

Cross-Resistance

When a microorganism that is resistant to one antimicrobial drug also becomes resistant to other, often chemically unrelated, drugs.

Clinical Infections

Infections that occur in patients who seek medical care, often exacerbated by AMR, which complicates treatment options.

Global Health Security

The collective effort to address health threats that transcend national borders, including AMR, which requires international cooperation and action.

Bacteriophage

A genetically engineered virus designed to work as an antibacterial drug that could be used as a replacement for current antibiotics. Especially useful for dealing with AMR bacteria

General Overview

The Drivers of AMR

There are several key drivers contributing to the rise of AMR:

- Overuse and Misuse of Antimicrobials: Antibiotics and other antimicrobials are often prescribed unnecessarily or inappropriately, such as for viral infections (where they are ineffective) or for mild bacterial infections that the body could otherwise fight off.

- Self-Medication and Unregulated Access: In many parts of the world, antimicrobials are available without prescriptions, leading to misuse by patients who may not complete their courses or take incorrect dosages.
- Agricultural and Veterinary Use: The use of antibiotics in farming, particularly in livestock to promote growth and prevent disease, contributes to resistance. Resistant bacteria from animals can transfer to humans through the food chain or direct contact.
- Poor Infection Control in Healthcare Settings: Inadequate infection prevention practices in hospitals, including poor hygiene, lack of sanitation, and overuse of antibiotics in intensive care units, contribute to the spread of resistant infections.
- Lack of New Antibiotics: There has been a stagnation in the development of new antibiotics, partly due to the high cost and low profitability of developing such drugs. This leaves fewer options to treat resistant infections.

Types of AMR

AMR manifests in several forms, each with varying degrees of impact on public health:

- Bacterial Resistance: The most common form of AMR, where bacteria evolve to resist commonly used antibiotics. Examples include *Methicillin-resistant Staphylococcus aureus* (MRSA) and *Escherichia coli* (E. coli) that are resistant to multiple drugs.
- Antiviral Resistance: Viruses, like the human immunodeficiency virus (HIV) or influenza, can evolve resistance to antiviral medications, making it harder to treat viral infections.
- Fungal Resistance: Fungi, including species responsible for infections like Candida, can develop resistance to antifungal drugs, complicating treatment for immunocompromised patients.
- Parasitic Resistance: Malaria parasites, for example, have developed resistance to several antimalarial drugs, making treatment regimens less effective in many regions.

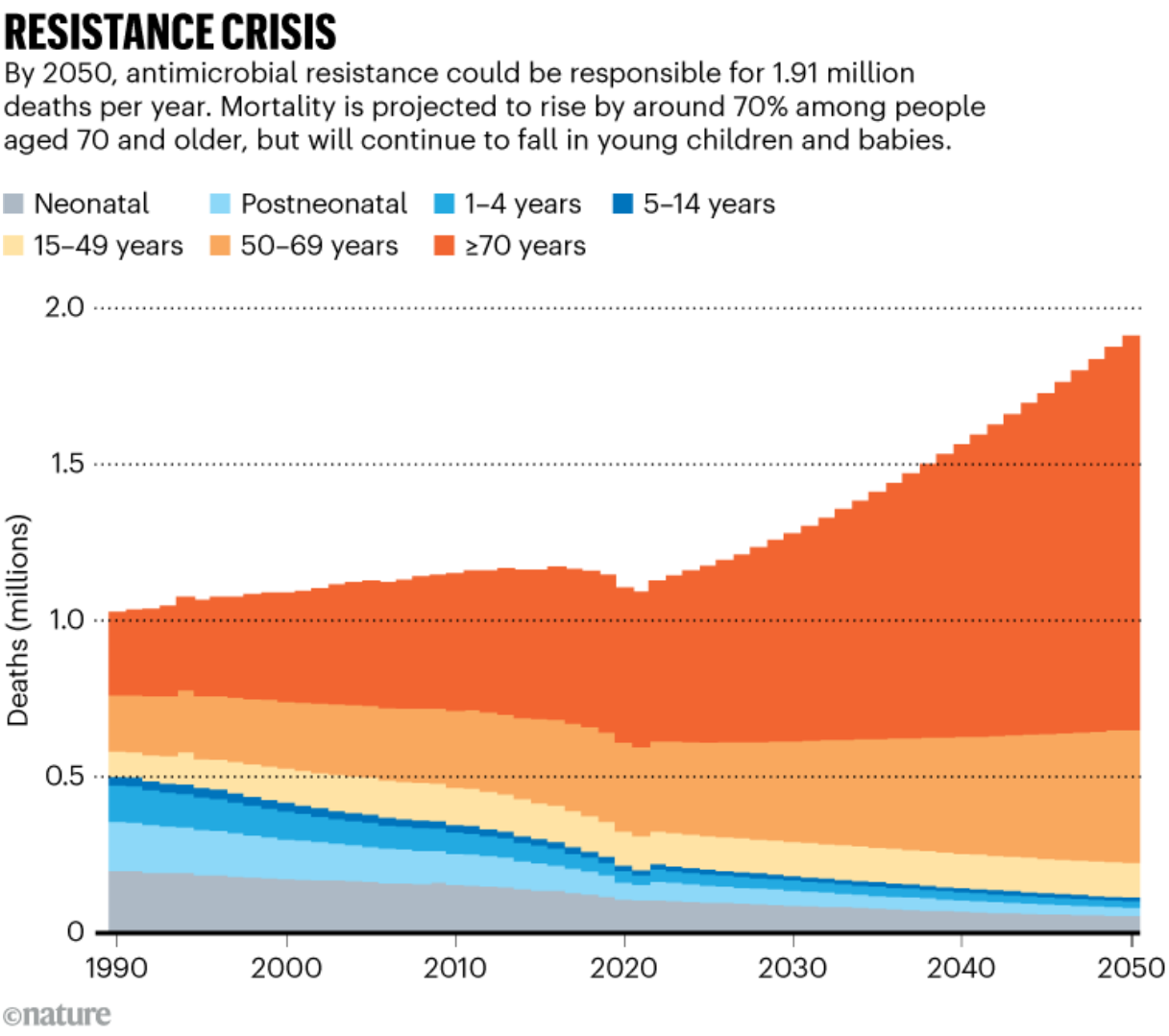
While these types are put under the single umbrella term of 'AMR', these types have varying degrees of prevalence and severity. Bacterial resistance has for example already been worked on by research on 'bacteriophages'. Other types have yet to gain prevalence and mostly impact certain regions. While not a priority topic, it could be important to take into account these distinct types and change policy accordingly.

Impact of AMR

The rise of AMR is having significant consequences across multiple sectors:

- Public Health: Resistant infections are leading to longer hospital stays, higher medical costs, and increased mortality rates. Routine medical procedures such as surgeries, cancer treatments, and organ transplants, which rely on effective antibiotics for infection prevention, become riskier in the presence of AMR.

- Economic Consequences: AMR leads to greater healthcare expenditures due to the increased need for alternative drugs, longer hospitalizations, and more intensive treatments. According to estimates, AMR could lead to a global economic burden of $100 trillion by 2050 if not adequately addressed.
- Global Health Security: AMR is a global threat that transcends national borders. Resistant infections do not respect political boundaries, and the spread of resistance can be exacerbated by international travel, trade, and migration.



This graph shows the predicted deaths due to AMR in the future. You can see that, while deaths in lower age groups continue to decline, especially older people are at high risk of death. Keep in mind that even though mortalities might keep decreasing, hospital costs will continue to rise as our efforts to combat these bacteria become more expensive.

As stated in the introduction, the rise of AMR is predicted to cause a decline in global GDP by 3,8% in 2050. While this number may seem small, it is important to recognise we are in the early stages of the AMR crisis. If not properly dealt with, microorganisms with AMR will only increase in prevalence and the issue will continue to rise. People infected with

microorganisms with AMR will have prolonged hospital stays, outside of costing more money, these people will also be unable to work for weeks or months, while previously a couple of antibiotics would have them working again. It is for these reasons that dealing with AMR is vital to global health policy. If not properly dealt with, its effects will exponentially increase in severity and eventually might even become impossible to deal with.

While AMR is an issue globally, certain regions suffer a great deal more than other areas. Antibiotics have been a cheap and accessible medicine to treat people in areas that have less access to good hospitals. With the rise of AMR people in these areas now stand defenseless against harmful microbes and with no access to proper healthcare facilities will have significantly higher mortality rates compared to

The Global Effort to Combat AMR

Addressing AMR requires coordinated, global action. Many international organizations and initiatives are dedicated to combating AMR, including:

- World Health Organization (WHO): The WHO has identified AMR as one of the top 10 global health threats, due to the danger it poses to global health, as well as the potential economic damages. They have developed a Global Action Plan to combat AMR, which includes measures such as improving the use of antibiotics, strengthening infection prevention, and increasing surveillance.
- The United Nations (UN): The UN has emphasized AMR in its 2030 Agenda for Sustainable Development, acknowledging its threat to health, food security, and development. On top of this, in 2024 the UNGA passed a declaration calling for a decrease in antibiotics usage and increased funding to the Health Emergency Preparedness and Response Authority (HERA) and other organisations.
- Antimicrobial Stewardship Programs: These programs aim to optimize the use of antimicrobials, reducing unnecessary prescriptions and ensuring the appropriate use of these drugs in healthcare settings.
- Research and Development Initiatives: There is an urgent need for investment in the development of new antimicrobials, vaccines, and diagnostic tools to combat resistance. Organizations like the Global Antibiotic Research and Development Partnership (GARDP) are working toward new drug discovery.

Challenges in Tackling AMR

Despite global recognition of AMR's importance, there are several challenges to effective action:

- Lack of Resources: Many low- and middle-income countries face significant challenges in accessing proper healthcare, including diagnostics, vaccines, and effective antimicrobials.

- Inadequate Surveillance: Without effective surveillance systems, it is difficult to monitor the emergence and spread of resistant infections, hindering early intervention efforts.
- Incentives for Pharmaceutical Companies: The development of new antibiotics is not financially attractive for many pharmaceutical companies, as the market for these drugs is limited due to their targeted use and short treatment duration.
- Public Awareness: There is a lack of awareness among the general public about the dangers of AMR and the importance of responsible antimicrobial use.

Major Parties Involved

World Health Organization (WHO)

The World Health Organization (WHO), established in 1948, is a UN agency focused on international public health. WHO leads global efforts to combat AMR through its Global Action Plan on Antimicrobial Resistance, which provides strategies to reduce antimicrobial use, improve infection control, and promote surveillance. WHO also monitors resistance trends via its Global Antimicrobial Resistance Surveillance System (GLASS) and works with governments to implement national policies on antimicrobial stewardship and resistance prevention.

United Nations (UN)

The United Nations (UN), founded in 1945, is an intergovernmental organization with 193 member states. The UN has recognized AMR as a critical global health issue, with the UN General Assembly adopting a Political Declaration on AMR in 2016. It promotes global collaboration and has integrated AMR into the 2030 Agenda for Sustainable Development, focusing on public health, food security, and access to medicines. The UN facilitates international policy dialogue and encourages multi-sectoral action to address AMR worldwide.

European Centre for Disease Prevention and Control (ECDC)

The European Centre for Disease Prevention and Control (ECDC), established in 2005, supports EU member states in preventing and controlling infectious diseases. ECDC monitors AMR trends across Europe through its European Antimicrobial Resistance Surveillance Network (EARS-Net), provides guidelines for antimicrobial stewardship, and offers technical assistance to countries in managing antimicrobial use. The ECDC also collaborates with WHO and other organizations to strengthen European and global responses to AMR.

The U.S. Centers for Disease Control and Prevention (CDC)

The Centers for Disease Control and Prevention (CDC) is the U.S. national public health agency, focused on disease prevention and control. The CDC monitors antimicrobial resistance in the U.S. through its National Antimicrobial Resistance Monitoring System (NARMS) and supports AMR surveillance, research, and education. The CDC also promotes antimicrobial stewardship programs in healthcare settings and collaborates internationally, working with WHO and the Global Health Security Agenda to tackle AMR globally.

The Global Antibiotic Research and Development Partnership (GARDP)

The Global Antibiotic Research and Development Partnership (GARDP), established in 2016, is a nonprofit initiative led by WHO and the Drugs for Neglected Diseases Initiative (DNDi). GARDP focuses on developing new antibiotics to treat resistant infections, particularly in neglected diseases like drug-resistant tuberculosis and neonatal sepsis. It works with pharmaceutical companies and research institutions to accelerate the development of new drugs, addressing the market failure in antibiotic development.

The World Bank

The World Bank, an international financial institution founded in 1944, supports global economic development. It recognizes AMR as a major threat to public health and economic stability. The World Bank provides funding for AMR-related research and helps countries integrate AMR prevention into their national health and economic development plans. The bank advocates for investment in new antimicrobial treatments and better governance to address AMR's economic and health impacts.

Global Health Security Agenda (GHSA)

The Global Health Security Agenda (GHSA), launched in 2014, is a multilateral initiative focused on improving global health security. GHSA promotes cooperation between governments, international organizations, and private sectors to tackle infectious disease threats, including AMR. It encourages countries to develop national action plans against AMR, strengthen healthcare infrastructure, and enhance surveillance, thus fostering a coordinated, global approach to combating antimicrobial resistance.

Timeline of Events

1928 - Discovery of Penicillin

Alexander Fleming discovers penicillin, the first true antibiotic, which revolutionizes the treatment of bacterial infections and lays the foundation for modern antibiotics.

1940s - Widespread Use of Antibiotics

Penicillin and other antibiotics (like streptomycin) become widely used in the treatment of infectious diseases, dramatically reducing death rates from bacterial infections.

1945 - Fleming Warns About Resistance

In his Nobel Prize acceptance speech, Alexander Fleming warns about the potential for antibiotic resistance, noting that bacteria could eventually develop resistance if antibiotics were misused.

1950s-1960s - Emergence of Resistance

As antibiotics are used more widely, bacteria begin to develop resistance. Penicillin-resistant strains of *Staphylococcus aureus* (MRSA) and *Streptococcus pneumoniae* are reported.

1970s - First Multi-drug Resistant Bacteria

The first reports of multi-drug resistant bacteria appear, with certain strains of *Mycobacterium tuberculosis* becoming resistant to multiple antibiotics.

1990s - Global Concerns Over AMR Begin

The 1990s see increasing alarm in the scientific community about the rapid emergence of resistant bacteria, especially in hospitals and healthcare settings, leading to growing concerns over the potential for untreatable infections.

2001 - WHO's First Global Report on AMR

The World Health Organization (WHO) publishes its first major report on antimicrobial resistance, highlighting the global rise in resistant infections and calling for international action to combat the issue.

2005 - European Commission Launches AMR Action Plan

The European Commission launches a comprehensive action plan to address antimicrobial resistance in the EU, focusing on improving the use of antibiotics, infection control, and research.

2011 - World Economic Forum Discusses AMR

The World Economic Forum (WEF) discusses AMR as a growing threat to global health and economic stability, emphasizing the need for urgent action to mitigate the problem.

2015 - WHO Global Action Plan on AMR

WHO launches its Global Action Plan on Antimicrobial Resistance, providing a roadmap for countries to tackle AMR, focusing on surveillance, stewardship, infection prevention, and the development of new antibiotics.

2016 - UN General Assembly High-Level Meeting on AMR

The UN General Assembly holds a high-level meeting on AMR, where countries adopt a Political Declaration on AMR, committing to take concrete actions to reduce resistance and improve antimicrobial use.

2017 - First Global Surveillance Report on AMR

WHO releases the first Global Antimicrobial Resistance Surveillance Report, detailing the global spread of antibiotic-resistant pathogens and calling for urgent action from governments and healthcare providers.

2018 - G20 Meeting Highlights AMR

The G20 summit includes AMR as a critical agenda item, encouraging nations to enhance surveillance, research, and the responsible use of antimicrobials.

2019 - The Interagency Coordination Group on AMR (IACG) Report

The IACG, established by the UN, publishes a report that warns AMR could lead to 10 million deaths annually by 2050, stressing the need for increased global cooperation and investment in new antibiotics.

2020 - COVID-19 Pandemic Raises AMR Concerns

The COVID-19 pandemic increases the use of antibiotics (often inappropriately), raising concerns about the exacerbation of AMR. The pandemic also underscores the need for better infection control and stewardship in healthcare.

2021 - The Global AMR Challenge

WHO and partner organizations launch a new campaign to raise awareness about the need for more robust actions against AMR, highlighting the growing threat of resistant infections in a post-pandemic world.

2024 - Increased Global Efforts and Research Investments

Global efforts to address AMR continue, with increased investment in research, development of new antibiotics, and global initiatives like the Global Antibiotic Research and Development Partnership (GARDP) accelerating the search for novel treatments.

Previous attempts to solve the issue

The WHO Global Action Plan on Antimicrobial Resistance (2015)

In 2015, the World Health Organization (WHO) launched its Global Action Plan on Antimicrobial Resistance. This plan was designed to guide countries in their efforts to reduce the spread of AMR by focusing on five key objectives: improving awareness and understanding of AMR, strengthening knowledge through surveillance, reducing the incidence of infection through better hygiene and infection control, optimizing the use of antimicrobial medicines in humans and animals, and investing in research and the development of new treatments. The plan has been adopted by many countries and remains a central framework in global AMR efforts.

The UN Political Declaration on AMR (2016)

In 2016, the United Nations General Assembly held its first high-level meeting on AMR, where member states adopted the Political Declaration on Antimicrobial Resistance. This landmark declaration committed countries to take urgent action to curb the rise of AMR. It emphasized the need for coordinated global action, highlighting the importance of reducing overuse and misuse of antibiotics, strengthening regulatory frameworks, increasing research into new antibiotics, and improving surveillance systems. The declaration was a major step in raising political awareness and promoting collective action against AMR at the international level.

Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach (2023)

In June 2023, the Council of the European Union adopted a recommendation aimed at intensifying actions to combat antimicrobial resistance (AMR) through a One Health approach, acknowledging the interconnectedness of human, animal, and environmental health. The plan sets ambitious targets, including a 20% reduction in human antibiotic consumption and a 50% decrease in antimicrobial sales for animals by 2030. It encourages member states to strengthen their national action plans, improve surveillance of AMR, and promote the prudent use of antimicrobials across sectors. Efforts also focus on improving animal health and welfare to reduce the need for antibiotics in food production. Additionally, raising awareness among the public and professionals in human and veterinary health is key, with training programs and public communication campaigns emphasized. AMR is a significant threat, causing over 35,000 deaths annually in the EU, and projections suggest that, without action, it could lead to 10 million deaths globally by 2050. The recommendation aims to address this crisis by fostering responsible antimicrobial use and preventive measures, but challenges include ensuring consistent implementation across EU member states and

maintaining long-term political and public commitment. By taking a comprehensive approach, the EU hopes to safeguard the effectiveness of antimicrobials and protect public health.

Possible solutions

Enhanced Global Surveillance and Data Sharing

A global, coordinated surveillance system that provides real-time data on antimicrobial resistance patterns can help to monitor and control its spread more effectively. This solution involves expanding international cooperation through organizations like WHO and the Global Antimicrobial Resistance Surveillance System (GLASS). Countries with limited resources could receive technical assistance to develop their own surveillance systems, ensuring that data is collected in a standardized way and shared internationally. Improved surveillance would allow for a better understanding of emerging resistant strains and enable quicker, targeted interventions, particularly in regions with high rates of resistance. This solution ensures that all countries, regardless of income, have access to critical data to make informed decisions.

Antibiotic Stewardship Programs with Economic Incentives

Developing and enforcing antibiotic stewardship programs globally can reduce the misuse and overuse of antibiotics. These programs should be mandatory for hospitals, healthcare centers, and veterinary practices, with the implementation of strict guidelines on when and how antibiotics should be prescribed. In countries with limited healthcare infrastructure, international partnerships could offer financial and technical support to set up these programs. To make stewardship sustainable, economic incentives could be introduced for healthcare providers and pharmaceutical companies that follow responsible prescribing practices and invest in alternatives to antibiotics. For instance, developing financial models that reward stewardship efforts with subsidies or grants for healthcare institutions could encourage their widespread adoption in both high-income and low-income countries.

Global Investment in New Antibiotic Development

There is an urgent need to develop new antibiotics to combat resistant infections, especially given the growing resistance to current treatments. A global initiative could be launched to pool resources for antibiotic research and development, supported by both governments and private sectors. This collaborative approach could take the form of public-private partnerships, where governments provide funding and tax incentives to companies developing new antibiotics. Special focus should be placed on the development of antibiotics that target infections common in low-resource settings, where the burden of resistant

diseases is particularly high. In parallel, mechanisms such as delinkage (disconnecting the revenue from the volume of sales) could be implemented to make new antibiotics affordable for all countries, ensuring that pricing doesn't restrict access to vital medications.

Useful documents

WHO Global Action Plan on Antimicrobial Resistance (2015)

https://www.who.int/publications/i/item/9789241509763

United Nations Political Declaration on AMR (2016)

https://digitallibrary.un.org/record/842813

European One Health Action Plan Against AMR (2017)

https://health.ec.europa.eu/system/files/2020-01/amr_2017_action-plan_0.pdf

Codex Alimentarius Guidelines (CAC/GL 77-2011)

https://www.fao.org/fao-who-codexalimentarius/sh-proxy/ar/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXG%2B77-2011%252FCXG_077e.pdf

The Interagency Coordination Group on AMR (IACG) Final Report (2019)

https://www.who.int/news/item/28-04-2019-un-interagency-coordination-group-on-antimicrobial-resistance-presents-its-report-to-the-un-sg

Bibliography

World Health Organization. "Antimicrobial Resistance." *WHO*, https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance. Accessed 30 Nov. 2024.

European Commission. "Antimicrobial Resistance." *Health - European Commission*, https://health.ec.europa.eu/antimicrobial-resistance_en. Accessed 30 Nov. 2024.

National Institute for Public Health and the Environment. "Antimicrobial Resistance." *Rijksinstituut voor Volksgezondheid en Milieu (RIVM)*, https://www.rivm.nl/en/antimicrobial-resistance. Accessed 30 Nov. 2024.

Centre for Disease Control. "Antimicrobial Resistance." CDC, https://www.cdc.gov/antimicrobial-resistance/index.html. Accessed 30 Jan. 2025.

European Commission. "UNGA Political Declaration: Global Commitment to Combat Antimicrobial Resistance (AMR)." *Health*, https://health.ec.europa.eu/latest-updates/unga-political-declaration-global-commitment-combat-antimicrobial-resistance-amr-2024-10-01_en. Accessed 30 Jan. 2025.