

Antibiotic resistance: a global phenomenon



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Abstract

Antibiotic resistance is a global phenomenon that poses a significant threat to public health worldwide. The overuse and misuse of antibiotics have led to the emergence of antibiotic-resistant bacteria, making it challenging to treat infections that were once easily cured with antibiotics. Antibiotic resistance has been observed in various settings, including hospitals, communities, and agricultural practices, and it affects people of all ages and backgrounds. The consequences of antibiotic resistance are severe, resulting in prolonged illnesses, increased healthcare costs, and higher mortality rates. Therefore, urgent action is required to address this global crisis, including the development of new antibiotics, better infection prevention and control measures, and responsible use of existing antibiotics.

1. Introduction

1.1 Antibiotics

Antibiotics are substances that are produced by a microorganism (e.g. bacterium, fungi) and in dilute solutions have the ability to destroy or inhibit the growth of other microorganisms. They kill bacteria or prevent them from reproducing and spreading. Alexander Fleming discovered penicillin, the first natural antibiotic, in 1928.

1.2 How Antibiotics work?

- Antibiotics attacks the coating or we can say destroy the surrounding of bacteria.
- It slows bacteria production and protein production in bacteria.
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1.3 How long do antibiotics take to show their action?

- Antibiotics start work after taking it or sometimes the work or action depend on the type of infection you tried to cure.
- Most of the antibiotics should be taken approximately for 2 weeks for better cure.

1.4 Antibiotics resistance

When micro-organisms are no longer controlled or eliminated by antibiotics, antibiotic resistance occurs. Human or animal do not produce resistance and only the microorganism produce resistance. They cause the infections which are harder to treat as the antibiotics used for the treatment are no longer effective.

1.5 Basic mechanisms of antibiotic resistance

1. Limiting uptake of a drug
2. Drug target alterations
3. Inactivating a drug
4. Active drug efflux
5. Alternative enzymes
6. Gram negative bacteria uses all four mechanisms and the gram positives uses all mechanism except the limiting uptake of drug and active drug efflux.

Table.1: Antibiotics, their mechanism, and mechanisms of resistance [2-14]

Category	Mode of action	Major mechanism of resistance
Beta- lactum	Inhibition of cell wall synthesis	Cleavage by beta-lactamases, ESBLs, CTX-mases, Carbapenemases altered PBPs
Aminoglycosides	Inhibition of protein synthesis	Enzymatic modification. Efflux, ribosomal mutations, 16 S rRNA methylation
Quinolones	Inhibition of DNA replication	Efflux, modification, target mutation
Glycopeptides	Inhibition of cell well synthesis	Altered cell wall, efflux
Tetracycline	Inhibition of translation	Mainly efflux
Rifamcylines	Inhibition of transcription	Altered submit of RNA polymerase
Sreptogramins	Inhibition of cell wall synthesis	Enzymatic cleavage, modification efflux
Oxazolodionones	Inhibition of formation of 70s ribosomal complex	Mutations in 23s rRNA genes followed by gene conversion.

1.6 Challenges to Antibiotic Resistance:

The usage of antibiotics has increased globally, new resistance are spreading in all over the world and we are not able to treat common infection. A growing number of infections, including pneumonia, tuberculosis, blood poisoning, gonorrhoea, and food and water diseases, are becoming more difficult, and in some cases impossible, to treat as a result of the decrease in antibiotic effectiveness brought on by the bacterial resistance. When antibiotics bought for human and animal without prescription, the spread and emergence resistance become worse, in other words we can say that misuse and overuse of antibiotics is increasing the process of antibiotic resistance through which the condition is becoming dangerous. As more and more resistance produce effective treatment of any infection decreases. When antibiotics used to treat infection are no longer effective, then the higher dose and expensive antibiotics are prescribed which increases the duration of illness and treatment along with the cost of treatment leading to economic burden on the family and society. The occurrence of antibiotic resistance places the success of modern medicine or treatment at risk. Organ transplantation, chemotherapy and surgeries become much more dangerous without antibiotics because chances of infection are high during the chemotherapy and surgery and to prevent the infection antibiotics is required.

1.7 Prevention and control

- Use antibiotics only prescribed by certified health professional.
- Always follow the advice of your doctor regarding antibiotics.
- Never use leftover medicine.
- Follow WHO five keys (Keep clean, separate raw and cooked, cook thoroughly, keep food at safe temperatures, use safe water and raw materials).

1.7.1 Policy makers

- Many policies are being made at national level to tackle antibiotic resistance.
- Improve surveillance of antibiotic-resistant infections.
- Strengthen polices and encourage people to follow the policy made by the authorities.
- Regulate and promote the use and proper disposal of quality medicines.

1.7.2 Health professionals

- Prevent infections by ensuring the working of instrument, and to clean environment.
- Health professional should only prescribe and dispense antibiotics when needed and should be prescribed according to the guidelines.
- Report antibiotics-resistant infections to the surveillance teams.
- Explain the patients about how to take medicine with proper dosing and proper timing and acquaint them with the knowledge about the misuse of antibiotics and how this can be dangerous to their life and health.
- Healthcare Industries- Invest more in research for the development of new antibiotics as the older one are not effective because of resistance.
- Encourage the researchers in field of antibiotics as this is very much needed.

1.7.3 Restricted antibiotics:

- Red – Highly Restricted
- Orange- Restricted
- Green-Unrestricted

1.7.4 List of restricted antibiotics are:

Amikacin, Amphotericin B, Aztreonam, Ciprofloxacin, Ceftazidime, Chloramphenicol, Flucytosine, Linezolid, Meropenem, Nalidixin, Piperacilin + Tazobactam, Sodium Fusidate, Tobramycin, Cefuroxime, Ertapenem.

1.7.5 Current approaches and future directions:

To tackle the emergence of antibiotics resistance, alternative treatment or strategies are designed to reduce the use of antibiotics for further clinical use. Kalan and Wright 2011 explained the idea of co-administering antibiotics with other drug which enjoy the success in the past through either synergistic or additive effects reduce the antibiotic resistance. Idea of administering other drug with antibiotics also enhanced the effect of antibiotics by combatting the bacterial resistance or also allowing the lower doses of antibiotics to be used.

1.7.6 Modifying enzyme inhibitors

Bacteria employ enzymes to destroy the antibiotics and to produce resistance if the enzymes are destroyed or inhibit then antibiotics resistance should be reduced. These enzymes are categorized by both substrate and the action. Transfer a functional group to the antibiotics and the action of redox and lyase [15]

1.7.7 Beta lactamase inhibitor

- Aminoglycoside – modifying enzyme inhibitors
- Membrane permeabilisers
- Efflux pump inhibitors

1.7.8 WHO Response: [16]

Tackling antibiotic resistance is a complicated task for WHO. In 2015, World Health Assembly planned a global action on microorganism resistance including antibiotic resistance.

Five strategic goals make up the "Global Action Plan on Antimicrobial Resistance":

1. Educate people about the antibiotic resistance and its harmful effects.
2. Support research and surveillance related to antibiotic resistance.
3. Lower the occurring of infection
4. To make the best possible use of antibiotics.
5. To ensure sustainable investment in countering antimicrobial resistance

Heads of State supported a political statement at the United Nations General Assembly in New York in September 2016 that showed the world's commitment to adopting a comprehensive, coordinated approach to address the causes of antimicrobial resistance across many sectors, particularly human health, animal health, and agriculture. WHO is aiding Member States in developing national antimicrobial resistance action plans based on the global action plan.

Several projects have been led by WHO to address antibiotic resistance:

- *World Antimicrobial Awareness Week (WAAW)*: Since 2015, WAAW is observed annually from November 18 to 24, with the goal of raising awareness of antimicrobial resistance throughout the world and motivating individuals, healthcare professionals, and policymakers to take action to prevent the emergence and spread of infections due to their drug resistance. Antimicrobials have a crucial role in the fight against infections that affect people, animals, and plants. Antibiotics, antivirals, antifungals, and antiprotozoa are some of them. The phrase "Antibiotics: Handle with Care" was originally used, but in 2020 it was changed to "Antimicrobials: Handle with Care" to reflect the growing prevalence of infections with drug resistance.
- *The Global Antimicrobial Resistance Surveillance System (GLASS)*: The antimicrobial resistance data collection, analysis, and sharing system supported by the WHO encourages as a standardized approach to global decision-making and drives local, national, and regional action.
- *Global Antibiotic Research and Development Partnership (GARDP)*: Through public-private partnerships, GARDP, a joint project of WHO and Drugs for Neglected Diseases Initiative (DNDi), promotes novel antibiotic research and development. By 2023, the public-private collaboration hopes to improve already available antibiotics and hasten the introduction of new antibiotic medications in order to develop and supply up to four new therapies.
- *Interagency Coordination Group on Antimicrobial Resistance (IACG)*: The United Nations Secretary-General has established IACG to improve coordination and communication between international organizations and to ensure effective global action is taken against health security. The Deputy Secretary-General of the UN and the Director-General of the WHO co-chair the IACG, which is made up of high-level representatives of pertinent UN agencies, other international organizations, and individual specialists from other fields.

2. Conclusion

In conclusion, antibiotic resistance is a global phenomenon that poses a threat to public health worldwide. The overuse and misuse of antibiotics, as well as their use in agriculture, have contributed to the development of resistant bacteria. To address this issue, it is crucial to promote responsible use of antibiotics, develop new antibiotics, and implement infection prevention and control measures. Failure to take action now could lead to a future where common infections become untreatable, highlighting the urgent need for collaborative efforts from all stakeholders to combat this global crisis.

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