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A review on Antimicrobial resistance (AMR)

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Abstract

Antibiotic resistance is a worldwide public-health emergency. Each year, multidrug resistant pathogens kill about 58,000 infants in India alone. Antibiotic misuse, a global occurrence, is a key generator of drug resistance. Antibiotic resistance is reaching alarmingly high levels across the globe. New resistance mechanisms are evolving and spreading throughout the world, posing a danger to our ability to treat common infectious diseases. Antimicrobial resistance (AMR) has emerged as one of the most important public-health risks, posing serious challenges to the successful prevention and treatment of chronic diseases. antibiotic resistance is mostly induced by antibiotic overuse and misuse. Antimicrobial resistance can develop naturally as a result of ongoing antimicrobial exposure. Natural selection refers to organisms that can adapt to their surroundings, survive, and continue to reproduce. Antimicrobial use and abuse in human, animal, and environmental sectors, as well as the transfer of resistant bacteria and resistance determinants within and between these sectors and around the world, are all causes of antimicrobial resistance. Most antibiotic classes used to treat bacterial infections in humans are also utilized to treat bacterial infections in animals. Given the importance and interdependence of antimicrobial resistance's human, animal, and environmental elements, it is logical to tackle the problem from a One Health

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perspective. This involves taking steps to ensure that existing antimicrobials continue to be effective by minimizing inappropriate use and controlling the spread of illness.

Keywords: Misuse, Antibiotic Resistance, Mechanism of action, Prevention

Introduction: Although the issue has long been understood by microbiologists and experts in infectious diseases, Sir Alexander Fleming, the discoverer of penicillin, himself called attention to the possibility of resistance from under dosing. However, a wider audience is just now becoming aware of the seriousness of the resistant threat. Numerous infectious pathogens that were formerly successfully treated with any of several different pharmaceutical classes have become resistant to the majority, if not all, of these medications. Antibiotics and synthetic antibacterial antimicrobial medications, the focus of this study, are most at risk, but antifungals, antiparasitics, and antivirals are also in danger. When bacteria develop defenses against the effects of antimicrobials (drugs used to treat illnesses), this phenomenon is known as antimicrobial resistance (AMR). Every class of germ has the potential to develop antibiotic resistance. Resistance to antifungal agents develops in fungi. Antiviral resistance among viruses develops over time. Both bacteria and protozoa can develop resistance to antibiotics. Antimicrobial resistance is the term used to describe all of these things collectively. Multidrug-resistant (MDR) microbes are sometimes referred to as superbugs and are resistant to numerous antimicrobials. Although antimicrobial resistance is a naturally occurring process, it frequently results from inappropriate antibiotic consumption and illness treatment.

Modern medicine was changed and the therapeutic perspective was altered by the discovery, commercialization, and routine administration of antimicrobial agents to treat infections. Antibiotics have indeed become one of the most crucial medical treatments required for the development of sophisticated medical approaches, including, among others, solid organ transplantation, cutting-edge surgical techniques, and the management of cancer patients. Unfortunately, the success of critically ill patients' treatments is increasingly under jeopardy due to the dramatic rise in antimicrobial resistance among common bacterial pathogens. According to the findings of many studies, bacterial resistance to antibiotics has not generally grown, particularly in Europe and North America. The introduction of a novel antimicrobial drug, whether in human or veterinary clinical use, has often been linked to increases in the incidence of resistance in certain bacteria, however the prevalence of resistance that is acknowledged may be quite low. It appears that using antibiotics in cattle production over the past 20 years hasn't had a negative impact on public health. The use of antibiotics in humans, not their use in agriculture, has caused any issues with bacterial resistance in human medicine.

The misuse of antibiotics:

Antimicrobial resistance is a growing problem worldwide. Misuse and overuse of antibiotics is the m ain driver of antibiotic resistance. Overuse and misuse of antibiotics in humans and animals is the ca use of resistance to disease. Antimicrobial resistance leads to longer hospital stays, higher medical c osts and increased mortality.

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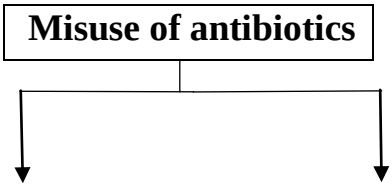
Misuse of antibiotics has led to the development of antibiotic-resistant bacteria, which can result in fatal infections and other serious illnesses.



In hospital practice	In primary health care
If receiving an antibiotic is not essential, the medication is not right for the patient, or the dosage is incorrect, then the antibiotic therapy is improper. This may be due in part to: (1) poor clinical decision-making; (2) lack of laboratory support or failure to use it; (3) ignorance of the types of bacteria most likely to cause specific infections; (4) insufficient knowledge of the suspected causal agent's current susceptibility to antibiotics; and (5) ignorance of the pharmacokinetic properties of specific antibiotics.	Quantitative data on primary care physicians' practices for prescribing antibiotics are few. What is available is from advanced countries and indicates significant usage in the management of fever episodes, diarrhea, and mild upper respiratory tract infections.

Mechanisms of Antibiotic Resistance:

Antimicrobial resistance occurs when bacteria, such as bacteria and fungi, develop resistance to drug s designed to kill them. Antibiotics can be difficult and sometimes impossible to treat. Antimicrobial resistance is a process that occurs.

Antimicrobial resistance is faster when antibiotics are present, and antibiotics cause bacteria and fun gi to change. Antibiotics and antibiotics kill disease-

causing bacteria, but they also kill the good bacteria that protect our bodies from infection. Resistant bacteria survive and multiplyIn the sections that follow, we'll concentrate on the molecular and biochemical causes of bacterial resistance while emphasizing particular conditions that are frequently observed in hospitals.

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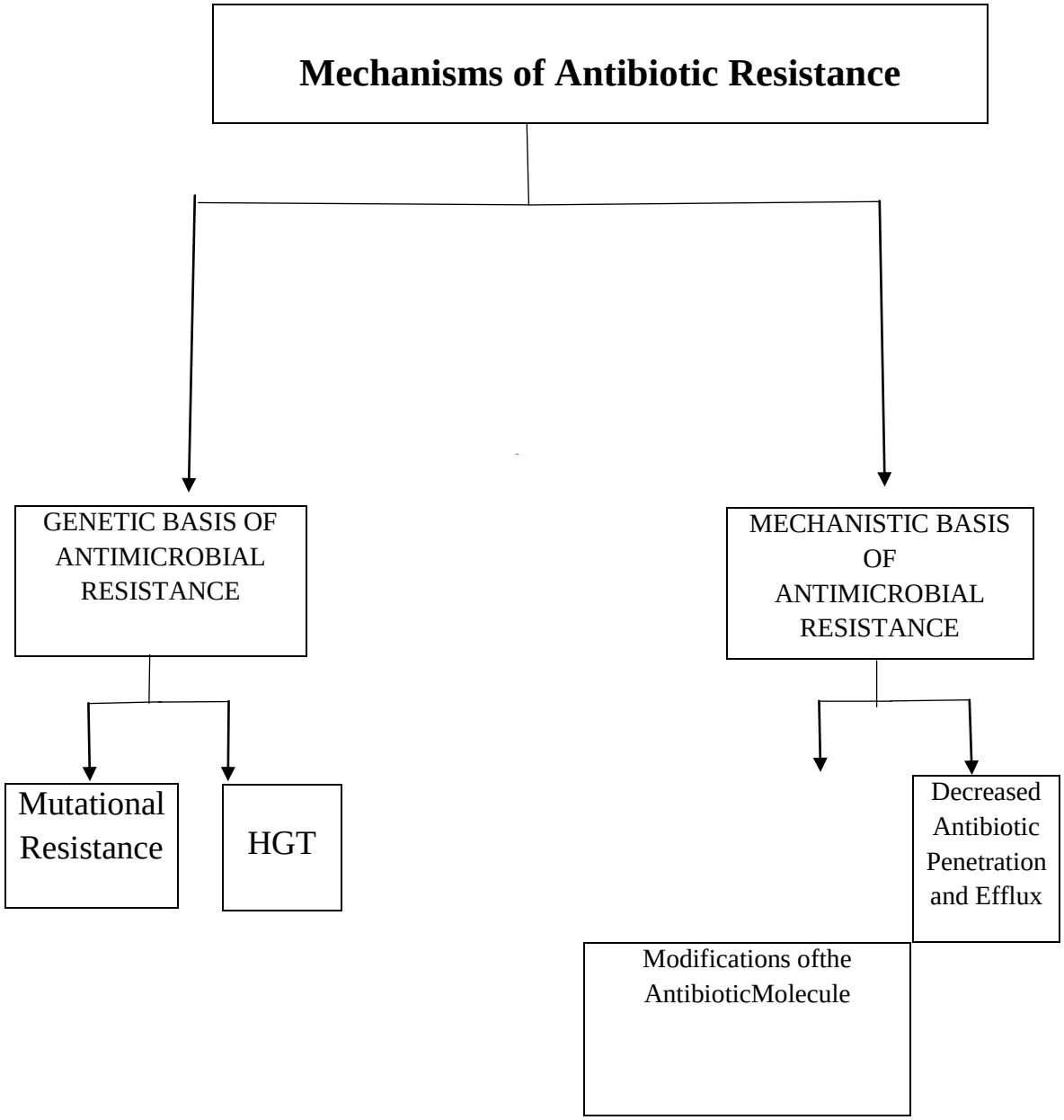

1. **GENETIC BASIS OF ANTIMICROBIAL RESISTANCE:** To respond to the "attack" of the antibiotic, the bacteria adopt two main genetic strategies: (i) mutations in the gene(s) frequently linked to the compound's mechanism of action; and (ii) acquisition of foreign DNA coding for resistance determinants by horizontal gene transfer (HGT).

(a). Mutational Resistance: Typically, mutations that cause antimicrobial resistance change the way antibiotics work through one of the following mechanisms:

(i) Alterations to the antimicrobial target (decreasing the target's affinity for the medication.
(ii) A reduction in drug uptake.
(iii) An activation of efflux mechanisms to expel the harmful molecule.

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(b). HGT (horizontal gene transfer)

Bacteria acquire genetic material through a mechanism known as horizontal gene transfer (HGT). By obtaining resistance genes from other bacteria, this is the most typical method by which bacteria develop antibiotic resistance.

The three main types of horizontal gene transfer are

Transformation, Conjugation, and Transduction.

(i) Transfer is when recipient cells have the capacity to advance extracellular DNA.
(ii) Conjugation is the transfer of DNA from one organism to another by direct contact.
(iii) Transduction is the transfer of DNA from one pathogen to another by a bacteriophage.

2. **MECHANISTIC BASIS OF ANTIMICROBIAL RESISTANCE:** According to the metabolic pathway involved in resistance, we shall group them into the following categories:

The four main types of resistance are: -

(i) Changes to the antimicrobial molecule.
(ii) Preventing the antibiotic from reaching the target site (by reducing penetration or actively extruding the antibiotic compound).
(iii) Altering and/or avoiding target sites.
(iv) Resistance brought on by global cell-adaptive processes**.**

The future of antibiotics: - Over the past 80 years, more than 140 antibiotics have been created for human use. Growing economic and societal costs are associated with antibiotic resistance, a global public health issue. Worldwide, antibiotic-resistant bacteria are responsible for 700,000 fatalities annually, and by 2050, it is anticipated that resistance will be more deadly than cancer.

Even though the market for novel antibiotic research and development (R&D) is failing, antibiotic resistance is still growing. Barriers in the fields of science, business, and regulation all play a role in the antibiotic market failure.

Antimicrobial resistance is a complex and evolving problem that requires a multifaceted approach. The future of AMR will depend on continued research and development of new antimicrobial agents, as well as the implementation of effective strategies to prevent the spread of resistant infections.

In addition to the strategies I mentioned earlier, there are several other approaches being explored to address AMR. These include:

(i) Development of new antibiotics and alternative therapies.
(ii) Use of bacteriophages and other biological agents to treat infections.
(iii) Development of vaccines against resistant pathogens.

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(iv) Implementation of infection prevention and control measures in the community setting

Prevention: Possible methods to deal with the problem of antibiotic resistance

Using materials whose resistance changes: The creation of substances that enable bacteria to revert from their resistant state is one method for suppressing microbial resistance. These substances, which stop the medication from being eliminated by efflux pumps, include phenylalanine, arginine, and phenyl amide. Another illustration would be the beta lactamase inhibitors clavulanic acid and sulbactam.

Therapeutic phage: The foundation of phage treatment is the employment of a unique class of viruses that can attack particular types of bacteriophages are often a component of the bacterial ecology that governs the population of bacteria in the gut, seas, soil, and other ecosystems. Between 1920 and 1940, both America and Europe tried phage treatment on people. Phage therapy's efficacy has been debatable, and several unsupported research have been carried out to demonstrate its value. Phage treatment was continued in the Soviet Union despite the abandonment of antibiotics by Europe and America following the discovery of penicillin in 1940. Phage treatment has gained interest once again as a result of the growth of antibiotic-resistant microorganisms.

Nutrition removal: Potentially replacing the need for antibiotics with the removal of nutrients. The human body stops the spread of germs by limiting the iron accessible to them. To stop pathogen development and subsequent infection, scientists are creating chelators to absorb the iron that is accessible to them.

Utilizing probiotics: Antibiotic-resistant organisms are currently being controlled by probiotics. Probiotics are microorganisms that inhibit pathogen colonisation by acting as a coexisting competitor.Probiotics must not be damaging to health, be resistant to bile and acid, have long-term survival in the gastrointestinal environment, stick to intestinal epithelial cells, be able to create antimicrobial agents, and control and modulate immune responses. Streptococcus, Bifid bacterium, and Lactobacillus strains make up the majority of probiotic bacteria. For generations, these bacteria have been employed in the manufacture of fermented dairy products.

Preventive strategies: The major clinical strategies for ABR prevention are:
(a). infection control.
(b). infection-specific prevention protocols.
(c) antibiotic management strategies.

Conclusion:

The development of antibiotic resistance can be greatly influenced by heteroresistance, persistence, and tolerance, according to earlier study. A number of different causes, such as incorrect antibiotic prescription and sales, the use of antibiotics outside of the health care industry, and genetic components inherent to bacteria, have all contributed to the rise in AMR. Inadequate financial incentives for pharmaceutical companies to develop new antimicrobial medicines have made the issue worse. The study's participants had a poor understanding of antibiotics and the consequences of

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using them improperly. No participant was able to define the term "antibiotics" accurately. Participants were more likely to buy drugs straight from a pharmacy without a prescription if they had less convenient access to an allopathic doctor, whether for logistical or financial reasons. At the end, we require fresh antibiotics to treat our patients. But when those new medicines are made available, we also need to safeguard them from abuse. Disruptive methods that question ingrained orthodoxy will be required if we are to end the cycle of resistance and alter the present environment. To prevent AMR, it is important to use antibiotic sonly when needed and applied correctly. Antibiotic treatment programs ensure that antibiotics are used appropriately and only when needed. Immunization is another important strategy for preventing diseases that can cause AMR. Infection prevention and control measures, such as hand hygiene and environmental hygiene, are also important to prevent infections that can cause AMR. Finally, tracking AMR patterns can help identify vaccine availability and inform public health responses.

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