

Worldwide Threatening Sign: Antibiotic Resistance Its Prevention and Control

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Abstract

Antimicrobial agents play a key role in controlling and curing infectious diseases in different fields of medical. Transitorily after the sighting of various groups of antibiotics and the use of antibiotics has increased globally, the challenge of antibiotic resistance has come into the picture worldwide on a very serious note. Based on the mechanism of action of antibiotics they are broadly classified as: Bactericidal and bacteriostatic. Antibiotics are a very important major part of antimicrobial drugs which have numerous categories, each with dissimilar targets. Subsequently, bacteria are endlessly using methods to overcome the effectiveness of antibiotics by using diverse several types of mechanisms. In this review, we have illuminated expansively various aspects of antibiotic resistance viz. overview of the antibiotic era, categories of antibiotic resistance, and numerous reasons for resistance. Certain recommendations to prevent the spread and reduce the rate of resistance growth have been discussed. Also, various controls and future strategies that can be taken into consideration by various professionals as well as by policymakers and individuals to prevent antibiotic resistance are discussed.

Keywords: Antibiotic resistance, prevention, controls

INTRODUCTION

Antibiotics are currently the most important class of medications and one of the most important medical discoveries of the twenty-first century. Antibiotics saved lives during the COVID-19 pandemic and numerous other pandemics. Millions of lives have been saved thanks to antibiotics, which were

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unquestionably a gift from science to human society in the fight against bacterial microorganisms [1]. Sadly, the number of microbial diseases brought on by multidrug-resistant (MDR) bacteria is rising worldwide, and that may be a dangerous warning sign. The threat of upcoming, incurable microbial infections has grown steadily since the turn of the century [2].

Effective antibiotics make a successful recovery and patient well-being after difficult surgeries, immunosuppressive treatments, etc. possible. Antibiotics prescribed as a preventative measure are essential before treating cardiac patients with infectious complications. When treating odontogenic infections, antibiotics are a godsend. Antimicrobial resistance (AMR) poses a serious problem for entire healthcare organizations internationally [3].

AMR is an inevitable evolutionary outcome because all organisms undergo genetic mutations to

protect themselves from lethal selection pressure. As long as antibacterial medications are used against them (i.e., selection pressure is present in their environment), bacteria have a propensity to develop and use resistance strategies [4].

Since antimicrobial resistance (AMR) should be viewed as a natural expected progression, the prolonged abuse and ongoing excessive consumption of antibiotics are the main contributors to the public health emergency brought on by the unchecked spread of this phenomenon [5]. However, several additional factors are also largely to blame for the increase in its occurrences and prevalence [6]. For instance, “socioeconomic determinants” such as a lack of community hygiene measures, refined food, insufficient infection control in hospitals and clinics, antibiotic accumulation in the environment, and improper use in the production of animals and food [6].

Furthermore, a lack of effective antibiotics reduces the likelihood of managing immune system-compromising diseases like HIV, cancer, surgery, and diabetes, as well as their risk of prevention [7]. The prevalence of antimicrobial resistance will increase even though this is thought of as a natural process due to incomplete knowledge about the catastrophe of antibiotic resistance in accordance with passive human activities like inappropriate (faulty) prescription methods, inappropriate - excessive use of antibiotics by physicians and patients, and improper diagnosis of specific microbial diseases [8, 9].

Significant increases in antimicrobial resistance necessitate active screening for current environmental threats and thorough consideration of alternative strategies. As a result, an alliance of numerous stakeholders is needed to manage this crisis that threatens the entire world to implement operative, effective policies, and agendas [10].

TYPES OF ANTIBIOTIC RESISTANCE

The antibiotic resistance exhibited by bacteria can be of the following three types.

1. Intrinsic
2. Acquired
3. Adaptive

Intrinsic Resistance

Studies have revealed that a surprisingly large number of additional genes and genetic loci also contribute to this phenotype, which is mediated by the outer membrane of bacteria and active efflux in the intrinsic antibiotic resistome. It is a naturally occurring phenomenon that predates antibiotic chemotherapy and is present in every microbial disease.

To stop a serious global clinical threat, novel therapeutic strategies must be developed. Antibiotic resistance is rampant in both the environment and hospitals. Existing antibiotics may be used to treat intrinsically resistant bacteria thanks to the potential for inhibiting components of the intrinsic resistome in bacterial pathogens [11, 12].

Acquired Resistance

This type of resistance is obtained from environmental microbes that are already naturally resistant, either through horizontal gene transfer (adding exogenous DNA) or mutation of chromosomal DNA. One of the factors influencing bacterial evolution is the acquisition of exogenous genetic material via HGT (horizontal gene transfer). It most frequently causes resistance through bacterial conjugation, bacterial transduction, or bacterial transformation [13].

A competent bacterial cell's uptake of free DNA is a bacteriophage-mediated transfer of genetic material from a donor bacterial cell to a recipient bacterial cell. Direct physical contact results in the genetic material of one genetic material being transferred to another. Most significant horizontal gene transformation mechanism. Mutations in chromosomal DNA or horizontal gene transfer, which are

typically obtained from organisms already present in the environment, can change the genetic makeup of specific microorganisms. The movement of antimicrobial determinants between various bacteria is facilitated by mobile genetic elements like plasmids, transposons, and integrons, which are linked to AR genes [14].

Adaptive Resistance

Adaptive antibiotic resistance is a type of antibiotic resistance that is brought on by environmental signals. The regulation of gene expression may alter in response to environmental changes [12].

CAUSES OF ANTIBIOTIC RESISTANCE

Many factors are currently in play in the complex etiology of antibiotic resistance.

- These include insufficient regulations and usage ambiguities, a lack of knowledge about best practices that discourage excessive or ineffective use of antibiotics, the use of antibiotics to promote growth rather than infection control in poultry and livestock, and online marketing that makes low-grade antibiotics readily available without restriction [15].
- Sir Alexander Fleming also warned that the “public will demand (the drug) and then will begin an era of abuses,” so the primary cause of resistance evolution is the overuse of antibiotics. Antibiotics destroy delicate bacteria, but they leave behind resistant pathogens, which then proliferate and flourish due to natural selection. Antibiotic overuse is strongly discouraged, but it still happens everywhere in the world. According to several studies, 30% to 50% of the time, treatment indications, agent selection, and antibiotic therapy duration are incorrect [16, 17].
- Antibiotics are employed all over the world to encourage livestock growth.

An estimate states that about 80% of antibiotics are only sold for use as growth promoters and infection prevention in animals. Additionally, improper knowledge of the pathogens that cause a particular disease among medical professionals may result in overprescribing antibiotics or in the incorrect use of antibiotics, which results in antibiotic resistance. Inappropriate prescription and use of antibiotics are also a result of improper diagnosis [18].

Many times, patients take antibiotics on their own or disregard the clinician’s instructions, which results in the misuse of antibiotics and, ultimately, antimicrobial resistance. The following steps can be taken to prevent antimicrobial resistance.

1. Enhancing sanitation and hygiene.
2. Implementing infection control measures to prevent the spread of resistant bacteria.
3. Developing new antibiotics to combat resistant or still susceptible bacteria.
4. Improving communication techniques to maintain the potency of new and existing antimicrobials.
5. Careful use of antibiotics, encouraging new, quick diagnostics to reduce needless and empiric antibiotic therapy.
6. Advocate for vaccines and alternatives.

CONTROL AND PREVENTION

It is important to take precautions at all societal levels to lessen the effects and stop the spread of resistance.

How Can People (Individuals) Combat and Prevent Antibiotic Resistance?

Antibiotics should only be used when prescribed by a licensed healthcare provider, according to guidelines that must be followed to prevent and control the spread of antibiotic resistance. If a doctor says you do not need antibiotics, you should never insist on getting them. When using antibiotics, it is best to adhere to the recommendations of medical professionals. Never share or administer leftover antibiotics to patients. Aspects of prevention should be taught. For instance, infections can be avoided by regularly washing hands, hygienically preparing food, avoiding close contact with sick people, and maintaining up-to-date immunizations. The WHO’s Five Keys to Safer Food (keep clean, separate raw

from cooked, cook thoroughly, maintain food at safe temperatures, use safe water and raw materials) should be followed when preparing food. People should also choose foods that have not been produced using antibiotics to promote growth or prevent disease in healthy animals [19].

Policy Makers

According to WHO, policymakers have a critical role to play in slowing and controlling the spread of antibiotic resistance. A strong national action plan should be in place to combat antibiotic resistance, according to policymakers. The monitoring of infections with antibiotic resistance can be improved by policymakers. Policies, programs, and the application of infection prevention and control measures can be strengthened by policymakers. They must oversee and encourage the proper handling and disposal of potent medications. They must disseminate knowledge regarding the effects of antibiotic resistance.

The primary and most significant role that health professionals play in stopping the spread of antibiotic resistance is in prevention. By using sterile autoclaved instruments, good hand hygiene practices, and maintaining a clean operating room and hospital environment, health professionals can prevent infections. According to current recommendations, clinicians must prescribe and administer antibiotics when necessary. Inform surveillance teams of infections that are resistant to antibiotics as necessary. The proper use of antibiotics, antibiotic resistance, and the risks of misuse are all things that professionals need to teach their patients about. Clinicians must educate their patients on how to avoid contracting infections (such as vaccination, hand washing, and covering the mouth and nose when sneezing) [20].

Role of the Healthcare Industry

The healthcare sector can spend money on developing new vaccines, diagnostics, and other tools. To find newer, more effective antibiotic alternatives, researchers must put in the time and effort necessary. Social media's role in reducing antibiotic resistance.

Particularly since the COVID-19 pandemic, social media has gained significant attention. Many pharmaceutical companies promoted a wide range of medications. To raise awareness among people worldwide, the correct information and strict instructions can be promoted on social media platforms. Social media platforms can be used to periodically survey people about their beliefs and the results of online education programs designed to reduce and manage antibiotic misuse. The fresher medical professionals should be guided properly regarding antibiotic prescription writing [18, 21, 22].

CONCLUSION

Several factors are responsible for antibiotic resistance. Antibiotic resistance poses a threat to international security. This review urges all medical professionals, individuals, policymakers, etc. to work together to stop antibiotic resistance, particularly in light of the COVID-19 pandemic. The review also suggests well-established biomedical and clinical approaches to prevent antimicrobial resistance. There is also a need to focus on population-based and multidisciplinary research periodically.

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