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Antimicrobial Resistance: A Growing Global Public Health Risk

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Abstract

Antibiotics were one of the most significant discoveries of the twentieth century, saving millions of lives from infectious diseases. Because of the high selection pressure from increasing use and misuse of antibiotics over the years, microbes have developed acquired antimicrobial resistance to many drugs. AMR is primarily transmitted and acquired through human-to-human contact both inside and outside of healthcare facilities. A wide range of interconnected factors related to healthcare and agriculture govern the spread of AMR via various drug-resistance mechanisms. The unrestricted use of antimicrobials in livestock feed has been a major contributor to the emergence and spread of AMR. The prevalence of antimicrobial-resistant bacteria has reached an unprecedented level worldwide, posing a silent pandemic threat to global public health and necessitating immediate intervention.

Keywords: Antibiotics • Antimicrobial resistance • Anticancer • Diagnostics

Introduction

The therapeutic options for infections caused by antimicrobial-resistant bacteria are limited, resulting in significant morbidity and mortality with a high financial impact. The scarcity of new novel antimicrobials to treat life-threatening infections caused by resistant pathogens stands in stark contrast to demand. Immediate interventions to combat AMR include surveillance and monitoring, limiting the use of over-the-counter antibiotics and antibiotics in food animals, increasing access to quality and affordable medicines, vaccines, and diagnostics, and enforcing legislation. An urgent coordinated collaborative action within and between multiple national and international organisations is required; otherwise, a post antibiotic era may become a more real possibility than an apocalyptic fantasy for the twenty-first century. This narrative review focuses on the mechanisms and factors that contribute to microbial resistance, as well as key strategies for combating antimicrobial resistance.

Literature Review

Antibiotics are the "magic bullets" for fighting bacteria and are regarded as the most significant medical discovery of the twentieth century. Antibiotics have altered the therapeutic paradigm and continue to save millions of lives from bacterial infections. Antibiotics have truly been a blessing to humanity; not only do they have medicinal applications, but they have also been used for a variety of purposes, including animal husbandry and animal production, as preventive measures in many underdeveloped and developing countries for decades. Microorganisms have developed antimicrobial resistance as a result of their increasing use and misuse. Antimicrobial resistance refers to the ability of microorganisms such as bacteria, viruses, fungi, and parasites to thrive and grow in the presence of drugs designed to kill them.

Antimicrobial agents, which include antibiotics, antifungals, antivirals, disinfectants, and food preservatives, either suppress or kill microbe growth and multiplication. Antibiotics are a type of antimicrobial that is used to treat bacterial infections and antibiotic resistance. They are far more commonly used than any other type of antimicrobial. AMR is an unavoidable evolutionary phenomenon that all organisms exhibit through the development of genetic mutations in order to protect themselves from lethal selection pressure. Bacteria strive to develop resistance to antibacterial drugs in order to withstand environmental selection pressure, rendering these drugs ineffective. With the increasing use of antibiotics, particularly in developing countries, bacteria have ample opportunity to develop AMR, which has serious consequences such as increased morbidity and mortality.

Discussion

Antimicrobial-resistant bacterial infections have reached unprecedented levels in the twenty-first century, posing a silent pandemic threat to global public health and necessitating immediate intervention. Antibiotic resistance can occur in any country and affect anyone of any age or gender. With its current state, AMR is one of the most serious threats not only to global health but also to food security. A large number of interconnected factors related to healthcare and agriculture influence the evolution and spread of AMR. Furthermore, it can be influenced by factors such as pharmaceuticals, improper waste management, trade, and finance, making AMR one of the most complex public health concerns in the world.

Antimicrobial-resistant infection is now the third leading cause of death, trailing only cardiovascular disease. According to a major study published in January 2022, an estimated 1.27 million deaths were attributable to antimicrobial-resistant infections in 2019, while nearly 5 million deaths were associated with drug-resistant infections in some way. This figure is expected to rise to 10,000,000 per year by 2050, far outnumbering cancer deaths. Methicillin-resistant Staphylococcus aureus is a well-known example of the first "superbug," and it is associated with a high death toll from antimicrobial-resistant infections all over the world. Currently, 3.5% of active TB cases and 18% of previously treated TB cases worldwide are MDR-TB (Multidrug-Resistant Tuberculosis), and there is a growing concern for XDR-TB among many MDR-TB cases.

Although antibiotics are necessary in the treatment of bacterial infections, their overuse and abuse at inappropriate doses and durations has resulted in selection pressure and the emergence of resistant bacteria over the years. Aside from human healthcare, the emergence and spread of AMR in many developing countries has been a major contributing factor. To reduce the prevalence of drug-resistant bacteria, increased surveillance of the impact of excessive and unregulated use of antibiotics in animal feeds is required. Antibiotic resistance can have a therapeutic and preventive impact on human health.

Antibiotic resistance is an evolutionary response of bacteria to the threat of therapeutic antibiotics. Clinically, all targeted pathogens are susceptible to an antibiotic when it is first introduced, but bacteria develop resistance to it over time. From an evolutionary standpoint, bacteria adapt antibiotic action through chromosomal gene mutations or acquisition of foreign DNA via horizontal gene

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transfer that codes for resistance determinants. Mutations primarily affect three types of genes: those encoding antibiotic targets, antibiotic transporters, and regulators that repress transporter expression, resulting in antibiotic resistance. There is intriguing evidence to support the idea that antibiotic-resistance genes are derived from commensal or environmental bacteria.

Current investments in the development of new synthetic small and natural-product-derived molecules contrast sharply with the ever-increasing demand for novel antimicrobials to treat life-threatening antimicrobial-resistant infections. Based on their own reasoning, pharmaceutical behemoths have abandoned their interest in antibiotic discovery and have stopped increasing their significant antibiotics inventory since the 1980s. Fluoroquinolone was one of the last broad-spectrum antibiotics discovered in the 1980s and was introduced to the market in 1987. Since then, development has been scarce, with only a few new antibiotic groups in the pipeline. Antibiotic use is linked to resistance development, implying that resistance can be significantly reduced by avoiding unnecessary antibiotic use [1-6].

Conclusion

Antimicrobial resistance in bacteria evolves continuously, either through new chromosomal mutations or through HGT acquisition of drug-resistance genes. The gradual evolution of AMR over the previous two decades has created grave risk for global public health and is now regarded as the greatest health threat of the twenty-first century, severely limiting treatment options. MDR bacteria are frequently found in many common infections around the world, including respiratory, urinary, sexually transmitted, and tuberculosis infections. Meanwhile, new antibiotic development and supply have lagged significantly since the 1980s and are not keeping up with the rate of AMR development. The future of effective antimicrobial therapy appears bleak in light of the unprecedented evolution of infections caused by multidrug-resistant pathogens and a scarcity of new antimicrobials. Unless global coordinated actions are taken to halt the ongoing trend of AMR a post antibiotic era for the twenty-first century may be a more real possibility than an apocalyptic fantasy.Multiple factors are contributing to the global spread of antimicrobial resistance, posing a serious threat to both human and animal health. Antimicrobial-resistant infections are more difficult to treat, resulting in treatment failure and complications, as well as significant financial costs to individuals and the community.

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Conflict of Interest

There are no conflicts of interest by author.

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