


Chapter 7

Post–Antibiotic Era: A Lurking Global Threat

Shafa S. Contractor
Karnatak University, India

Suresh B. Arakera
 <https://orcid.org/0000-0002-6234-666X>
Karnatak University, India

ABSTRACT

The discovery of antibiotics was a breakthrough in the field of medicine in the late 1920s. Antibiotics have saved millions of lives ever since and even increased life expectancy. But due to their irrational use in humans, animals, and agriculture, there is a global concern about antibiotic resistance. The ‘magic bullets’ are no longer effective against ‘superbugs’, posing difficulties for the medical practitioners in treatment. The pathogens have evolved different resistance strategies for their survival: enzymatic inactivation of antibiotics, altering the movement of antibiotics across the cell, or modifying target sites that interact with the antibiotics. As the efficacy of the critical drugs wanes and the discovery of new antibiotics stagnates, exploration and use of alternative therapies could offer a much-needed solution. Researchers worldwide are constantly striving to find a solution to combat antibiotic resistance. Some of the alternative therapies and the regulatory measures to deal with antibiotic resistance are discussed in this chapter.

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INTRODUCTION

The discovery of antibiotics by the Scottish physician and microbiologist Alexander Fleming in 1928 is one of the breakthroughs in human history and the field of modern medicine. Until then, infectious diseases were considered the primary reason for human death. A study by Yoneyama and Katsumata (2006) inferred that contagious diseases were the leading cause of death worldwide in 1900. It is widely known that before the discovery of antibiotics, most Americans died, before reaching their forties, due to infectious bacterial diseases (Lin et al., 2017). The advent of antibiotics led to a significant decrease in morbidity and mortality (Ventola, 2015). Antibiotics were widely used during Worldwar-II against bacterial infections. It was known as the miracle drug, bringing a revolution in treating bacterial infections, and that marked the beginning of the ‘Antibiotic era’. Antibiotics selectively target pathogens and were believed to be without must negative effect on the host. They work efficiently in low concentrations and on a wide range of pathogens. Hence, they were also known as the ‘wonder drug’ and ‘magic bullets’ (Aminov, 2010). According to a report, since the use of antibiotics in the treatment, the life expectancy of men and women increased from 47 in the 1900s to 74 and 80 years in the year 2000 (Lederberg, 2000). According to the world health organization, antimicrobial drug is a collective term for medicines such as antibiotics, antivirals, antifungals, and antiparasitics used to treat bacteria, viruses, fungi, and parasites.

Antibiotics are compounds of low molecular weight mainly natural products, produced by microorganisms (e.g., Penicillin), or derivatives of natural products (e.g., Ampicillin). Some antibiotics are chemically synthesised, e.g., the Sulpha drugs. Some are even derived from the distillation of plant products, e.g., quinolones (Martens & Demain, 2017). Antibiotics have either a bacteriostatic or a bactericidal mode of action. They target the conserved pathways crucial for the viability of bacteria, such as DNA replication, cell wall synthesis, protein synthesis, and metabolism creating strong selective pressure for their survival (Kapoor et al., 2021). As a result, bacteria have evolved an array of defence mechanisms, making them resistant to antibiotics. These include modification of the antibiotic target, reduced permeability of the outer membrane, efflux pumps, and producing enzymes that can degrade antibiotics (Gordillo Altamirano & Barr, 2019). The ability of the bacteria to grow even in the presence of therapeutic levels of a drug is called antibiotic resistance. Prophylactic use of antibiotics in animal husbandry or self, incomplete antibiotic treatment, and easy availability of antibiotics without any medical prescription have led to the emergence of resistant strains in alarming numbers (Zaman et al., 2017). Moreover, the broad-spectrum activity of the antibiotics destroys the normal microbiome of the patients. The resident microflora shares a commensal relationship with the living organisms, playing vital roles in digestion and in developing immunity. They compete

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