PERSPECTIVE

The food chain and antimicrobial resistance: trends, mechanisms, pathways, and potential regulation strategies

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ABSTRACT

Since it has the potential to harm human health on a worldwide scale, Antimicrobial Resistance (AMR) continues to be of great interest to many food stakeholders. Food contamination can occur at any point, from the field to the store, due to antibiotic-resistant bacteria and/or genes (transfer in pathogenic microorganisms). Antibiotic-resistant bacterial infections are more common in Low- and Middle-Income Countries (LMICs) than in developed nations, according to research. Foodborne infections are the main cause of illness and death worldwide. Pathogenic microorganisms can be transmitted directly or indirectly from food to consumers. Consequently, a variety of national and international strategies are required to prevent the spread of foodborne diseases and to advance food security and safety. Zoonotic microorganisms can spread through the food chain, the environment, and living things. Antimicrobial medications are used all over the world to prevent infections in producing agriculture as well as to treat diseases in people and animals. According to research, food can pick up AMR bacteria (AMRB) along the supply chain from farm to processing to retail to consumer. Controlling antibiotic usage throughout food production is essential to reducing the risk of AMRB in people. This goes for both crop and animal agriculture. The key conclusions of this study are the means of entry of AMRB into the food chain during crop and animal production and other modes AMRB prevention and control measures; and the implications on human health if AMR is not addressed internationally.

Key Words: *Antimicrobial resistance/AMR; Food chain; Foodborne infection; pathogens; Food safety; Pathways of antimicrobial resistance; Regulatory guidelines*

INTRODUCTION

One of the main methods used in modern medicine to treat bacterial infections is antibiotic treatment. The majority of antibiotics used today were created between this times frame is known as the "golden era" of antibiotic development. Antibiotic resistance is a result of several reasons, including the failure to create or discover new medicines and the indiscriminate use of current antibiotics without the required prescription. The prevention and treatment of bacterial illnesses are now generally threatened by AMR. Swann was one among the first to raise concerns about the issues associated with the widespread use of antibiotics, stating that the massive amounts of antibiotics being administered without proper protocol may be harmful to human health. Several decades later, despite warnings, data reveals, for instance, about a million people died from diseases caused by antibiotic resistance, and the future is gloomy, with premature deaths predicted. The extensive off-label and uncontrolled usage and development of AMR may be an unexpected consequence of accessibility and affordability. AMR happens when microorganisms (such as bacteria, fungi, and viruses) come into repeated contact with antimicrobial chemicals (such as antibiotics), altering their physiology or genetic composition. For instance, "Superbugs" are bacteria that are immune to several antimicrobials. The "global resistome," also known as AMR, is a result of the misuse of antibiotics, worldwide trade in food and people, inadequate cleanliness, and the release of antibiotics that have not been digested into the environment. Foodborne infections linked to *Salmonella enterica serovar Typhimurium* of pig and poultry origin serve as an example of the impact on people. Food-producing animals (such as cattle, hens, and pigs) frequently receive prophylactic antibiotic treatment; it's expected that this use will have increased globally by approximately. Antibiotic overuse prompts worries about a rise in AMR in microorganisms. The World Health Organization (WHO)

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claims that just 32 WHO-priority infections are targeted by the newer antibiotics and 10 biological that are being evaluated, and that no targeted antimicrobials have been produced for the other pathogens. A non-profit organization called the "Global Antibiotic Research and Development Partnership" will have been established by the WHO and the "Drugs for Neglected Diseases Initiative" to develop new antibiotics that can combat antimicrobial-resistant organisms in order to provide better treatments. Due to low access to second-line antibiotics, restricted patient presentation, difficult diagnostics, and the threat of AMR, sickness and death are on the rise in LMICs. There is evidence between the rises in AMR of human illnesses with the indiscriminate abuse of antibiotics in agricultural agriculture. By consuming tainted food and dealing with animals that have the disease and biological such blood, urine, feces, saliva, and semen, people can become infected with AMRB indirectly. AMRB's rise is impacted by the usage of antimicrobials, biocides, and heavy metals in the food and agriculture industry. AMR genes may potentially contaminate food; for instance, a prior study revealed that *Escherichia coli* K12 may acquire *Salmonella Typhimurium* DT104-related ampicillin-resistant genes from ground beef and infected milk. The 'One Health' strategy supporting healthy people, healthy animals, and healthy environments was advised by the Food and Agriculture Organization (FAO), World Health Organization for Animal Health (OIE), and WHO. When it comes to having the resources necessary to implement the "One Health" strategy and stop the development of AMRB, LMICs are far behind. Due to the globalization of the food supply, the rise in urban population, and worldwide travel, AMR has spread quickly.

CONCLUSION

The worldwide population is being impacted by antimicrobial resistance, which is costing lives and money. The World Organization for Animal Health and WHO endorse the "One Health" concept, under which appropriate strategies may be created and put into practice to reduce AMR. Antimicrobial residues in food that may result from the indiscriminate use of antibiotics in agriculture are now the main areas of concern. At any stage along the continuum from farm to table, food and commodities might get contaminated with AMRB. To reduce or eliminate the danger of AMRB in the food chain, two key processes—the use of antimicrobials in food and AMRB arising from agricultural practices—need to be closely watched. The strategies should be policy-based, globally implemented, and fully supported by laws and regulations.