Editorial

Use of Antimicrobials in Food Animal Production and Their Impact on Human Health and Environment

Received: 10 June 2021 Accepted: 2 July 2021
doi: https://doi.org/10.3329/jemc.v11i3.66880

The discovery of antimicrobial agent is undoubtedly one of the greatest achievements in the history of medicine. Since their discovery, antimicrobials have made remarkable advances in the treatment of infectious diseases, saved many lives and significantly contributed to the control and prevention of infections.[1] In addition to human health, antimicrobial agents have been widely used in animal husbandry and veterinary medicine to treat infections, prevent diseases and promote growth that resulted in healthier and more productive farm animals.[2]

With the discovery of antimicrobials, it was thought that we had won the war against infectious diseases.[3] Majority of antimicrobials were discovered during the period 1940s and 1960s after the discovery of penicillin in 1928. This period is considered as the golden age of antimicrobial discovery. Then, a gradual decline in the rate of antibiotic discovery was observed after the 1970s. Lack of newer drug together with the development and spread of antimicrobial resistance (AMR) in many human pathogens has led to the current antimicrobial resistance crisis.[4] It is estimated that currently at least 700,000 people die each year due to drug-resistant diseases. If no urgent action is taken, AMR diseases could cause 10 million deaths each year by 2050.[5]

Several factors and mechanisms contributes to AMR — certain types of bacteria are naturally resistant, genetic mutations, transfer of resistance gene from another bacteria and the selection pressure from antimicrobial agents.[6,7] Improper prescribing and inappropriate use of antimicrobials in human and food animals (cattle, sheep, swine, poultry, fowl, fish or other animal) are important drivers for evolution of resistant genes that exert selection pressure and thus escalates the favorable mutation in the bacteria. For many years antimicrobials have been used frequently as therapeutic agent for the treatment of animal diseases, prophylactic agent to prevent infections and also a feed additive to promote growth in the commercial animal production.[5,7] Scientific evidence suggests that injudicious use of antimicrobials in the food animals are associated with several detrimental impacts such as they have some direct toxic effect on human health, evolution of AMR organisms and environment pollution. When the concentration of antimicrobial residues in the food animals cross the safe limit and we consume with our food, it may have direct adverse impact on human health; such as tetracycline may interfere with teeth development in young children, clenbuterol may cause food poisoning, muscle tremor, palpitation and tachycardia. Some authors noticed that the presence of low doses chloramphenicol residues in meat, milk and eggs intended for human consumption may cause aplastic anemia and gray baby syndrome in humans.[7] Sometimes long-term exposure at low levels may be involved in the development of allergies, cancers, anaphylactic shock, nephropathy, bone marrow toxicity, mutagenic effects and reproductive disorders.[8] In addition to direct effect on human heath, it is evidenced that the misuse of antimicrobials in food animals is an important contributor to the modern trend of the emergence and spread of AMR bacteria.[7] Then transmission of those resistant organisms from animals to humans can take place directly or indirectly with food consumption. Another common route is through direct or indirect contact with people working in close contact with animals, such as farmers and animal health workers and through manure contaminated environments and aquaculture. These resistant bacteria may infect humans that are

difficult to treat and therefore may lead to increased morbidity and mortality.[2]

The indiscriminate use of antimicrobials can result in higher concentrations of antimicrobials in the environment. Global antimicrobial consumption in livestock has been estimated as approximately 63,000 to 240,000 metric tons yearly.[9] Approximately 30–90% of the ingested antimicrobials are not absorbed by animals but excreted into the water and soils through urine and stool as parent compounds or their metabolite.[7] In addition to this source, including manure and slurry spreading, aquaculture treatment and inappropriate disposal of used containers and unused medicines can lead to the dumping of antimicrobial residues in water and soils.[8] The rate of antimicrobial excretion is believed to vary according to the chemical structure and dose as well as the animal age and species. These compounds may play an important role in the transfer, evolution and ecology of AMR genes. Results of good number of studies showed that long-term exposure of bacteria at low concentration of antimicrobials in environment appears to have a significant influence on bacterial genomes. This exposure has been found to modulate the transcription levels of about 5–10% of bacterial genes. Sub-inhibitory concentrations of antimicrobial can induce the bacterial SOS repair system, which in turn increases the frequency of gene mutation and horizontal gene transfer and mobile genetic elements, including those responsible for antimicrobial resistance.[7,10]

Effective implication of prevention and control measures from food producers, government and relevant organizations is needed to control the problems of use of antimicrobial in food animals. Increased consumption is directly responsible for the environmental contamination. Therefore antimicrobials should be used when necessary under the prescription of a veterinarian, without prescription selling or dispensing of antimicrobials must be stopped. Use of toxic antimicrobials use should be prohibited, withdrawal time, quality control and test for the presence of antimicrobial residues in food before marketing should be maintained strictly. Quick and cost effective tests should be developed to identify antimicrobial residues. Mass awareness should be developed among the concerned persons regarding the dangers of the misuse of antimicrobial in food animals.[8] Prevention of infections by vaccination could limit the use of the amount antimicrobials. Furthermore, use of probiotics, prebiotics and synbiotics to improve the immune system may also be considered.[2]

Evidence suggest that extensive use of antibiotics in food animal production is a major contributor for antimicrobial resistance. A global and comprehensive initiative should be taken from the governments, policymakers, relevant organizations, veterinarians, food producers and drug dispensers to restrict and monitor the inappropriate antimicrobials use in food animals to avoid the adverse effect on human health and environment.

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