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VETERINARY DRUG RESIDUES IN FOOD-ANIMAL PRODUCTS: A GLOBAL PUBLIC HEALTH CONCERN

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ABSTRACT

Antibiotics have been used in animal production for more than five decades now primarily to treat or prevent disease. In addition to this, the provision of antibiotics to food animals encompasses a wide variety of non-therapeutic purposes that include growth promotion which has led to their extensive use as antibiotic feed additives in animal feed at sub-therapeutic doses for extended periods. Although this has been beneficial for animal health and productivity, the prolonged and unregulated use of these antimicrobials has led to selection and dissemination of antibiotic resistant strains of antimicrobials. Consumption of food products of animal origin with residual antibiotic has become a major public health concern. Antimicrobial usage and antimicrobial resistance in animal production is now recognized to be an important contributor to the global problem of antimicrobial resistance. It is one of the most alarming problems faced by healthcare providers since the common bacterial infections are becoming difficult to treat due to antibiotic resistant bacteria. This represents a "One Health" challenge that urgently needs to be tackled by the international community. Well-designed, scientifically sound interventions aimed to tackle excessive antimicrobial usage through development of effective, safe and novel alternatives needs to be investigated in addition to formulation of regulations by the policy makers.

I INTRODUCTION

The discovery of antimicrobials has been a great achievement in medicine. Availability of effective antimicrobial therapy has had a huge impact on human and animal health, improved human and animal welfare, and enhanced the production of food. Antibiotics have been used to maintain animal health and production. In addition to their primary use for disease treatment, the provision of antibiotics to food animals encompasses a wide variety of non-therapeutic purposes that include growth promotion and improvement of feed efficiency. Global consumption of antimicrobials in animals is twice that of animals [1]. Antibiotic consumption in livestock is estimated to be at 63, 151 tons while it is projected that antimicrobial consumption will rise by 67%

by 2030 and nearly double in India [2]. This rise is likely to be driven by the growth in consumer demand for livestock products in middle-income countries and a shift to large scale farms where antimicrobials are routinely used.

However, on the other hand the rampant antimicrobial use for animal production has indirect adverse impact on human health. There is considerable debate in veterinary medicine regarding use of antibiotics in animals raised for human consumption (food animals). The increasing occurrence of potential drug residues in food products of animal origin in case of their wide and inappropriate use is an alarming trend since human health is related directly to the environment [3] and in particular to the quality of food consumed [4]. Pathogenic-resistant organisms propagated in these livestock are poised to enter the food supply and could be widely disseminated in food products [5]. This poses a serious health hazard and risk to the consumers when exceeding the thresholds of toxicological concern in food products of animal origin, including meat, eggs, and milk. With pharmaceutical activity and/or toxicity, food-borne drug residues can cause acute and chronic health consequences, posing direct health risk to humans. This paper shall review

II ANTIMICROBIAL USE AND ANTIMICROBIAL RESISTANCE

Antimicrobial resistance is one of the most pressing problems faced by healthcare providers in the current decade. It is alarming that common bacterial infections are becoming difficult to treat due to antibiotic resistant bacteria. The inherent consequence of widespread use of antibiotics in livestock is antibiotic resistance which is a looming public health crisis. It arises as a result of natural selection. Due to normal genetic variation in bacterial populations, individual organisms may carry mutations that render antibiotics ineffective, conveying a survival advantage to the mutated strain. In the presence of antibiotics, advantageous mutations an also be transferred via plasmid exchange within the bacterial colony, resulting in proliferation of the resistance trait. The emergence of drug resistance has been observed following the introduction of each new class of antibiotics, and the threat is further compounded by a slow drug development and limited investment in the discovery and development of new antibiotics. This has led to the emergence of antimicrobial-resistant bacteria which has significant public health implications: antimicrobial-resistant bacteria of animal origin can be transmitted to humans through the environment [6] or food products [7] and to agricultural workers by direct contact [8]. A close association between the prevalence of livestock-associated antimicrobial-resistant bacteria in animals and in humans [9], as well as between the levels of antimicrobial use in animals at a population level, and the prevalence of antimicrobial-resistant bacteria in animals [10] and in humans [11] has been suggested.

The selection and spread of those resistant bacterial strains that survive the presence of one or more classes of antimicrobials probably represent the most serious public health risk from antimicrobial use in food animal production [12]. There is a considerable scientific consensus that the antimicrobials used for treatment and prevention of bacterial infections and growth promotion in food producing animals have a significant

contribution in the emergence and spread of resistant bacteria [13], particularly the sub-therapeutic usage of antimicrobials in farms where a good number of animals are concentrated at high stocking rates, contributes significantly to the selection and propagation of resistant bacteria [14]. It has been suggested that agricultural antimicrobial use has important quantitative effects on the spread of antimicrobial resistance and the transmission from agriculture may even have a greater impact on human populations than hospital transmission of the resistant bacterial strains [15].

Because many antimicrobials used in food-producing animals are the same as or closely related to the medically important ones used in human health care, the emergence and spread of bacteria resistant to these drugs is a well recognized and imminent health risk. It limits the therapeutic options for human diseases and can cause prolonged illness, serious disability, and even death. It has been demonstrated that significant proportion of *Escherichia coli* infections in humans, particularly the strains resistant to antimicrobials, was transferred from food animals [16]. The prevalence of antimicrobial resistance in *Escherichia coli* isolates from blood stream of human infections has been shown to have a significant correlation with the resistance in *Escherichia coli* isolates from food animals (particularly poultry and pigs) from analysis of surveillance data in 11 European countries over the period of 2005 and 2008 [17]. Thus, there exists a link between antimicrobial resistance development in strains from food animals, animal farms, and humans which needs to be further researched upon.

III CONCLUSIONS AND RECOMMENDATIONS

European countries have gradually phased out the use of antimicrobial growth promoters in food-producing animals [18]. Because of antimicrobial resistance concerns, many countries have withdrawn approvals for their use for growth promotion such that antimicrobials are no longer approved for use as growth promoters in food-producing animals. This highlights the distinction that needs to be made between their therapeutic use which alleviates pain and suffering and growth promotion which aims to increase the rate of weight gain and improved feed efficiency thus achieving market weight in less time than if the antimicrobials were not in the feed. In recent years, the FDA has also discouraged the use of these antimicrobials as growth promoters in livestock and have published plans to phase out the use of these antimicrobials as growth promoters [19]. This regulation needs to be approved and implemented in our country as well. Because of antimicrobial resistance concerns, it is suggested that in the future that only therapeutic use be allowed in all jurisdictions and the veterinarian be given more involvement in directly managing microbial infection on livestock farms to ensure the prudent use of antimicrobials.

In addition non-prescription and over-the-counter sales of veterinary drugs should be banned at the earliest to ensure an end to the inappropriate antimicrobial usage which results in ineffective therapy and unnecessary animal suffering in an effort to address the residue and antimicrobial resistance concerns. Furthermore, it is essential to conduct rigorous and well-conducted scientific research to develop novel approaches such as the use

of emerging nanotechnology based drug delivery systems and the utilization of anti-microbial peptides as alternatives to the use of antibiotics.

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