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Use of Antimicrobial Agents in Veterinary Medicine and Implications for Human Health

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This review discusses why veterinary usage of antimicrobial agents is wrongly accused of causing a substantial part of the problem of resistant human pathogens. Without doubt, resistant organisms in animals are selected by veterinary antimicrobials. However, these are not a major human health risk either because the role of veterinary usage in selection or propagation is insignificant, or because resistant populations selected by veterinary usage do not pose a substantial risk to human health. Indeed, resistant bacterial infections in humans causing serious quantitative and qualitative health consequences are rarely food-borne and are not the same as those selected by veterinary usage of antimicrobial agents. The available evidence for veterinary selection of resistance, transmission to humans, and subsequent health consequences are reviewed for food-borne zoonotic pathogens. A risk assessment strategy is proposed to quantify potential hazards in order to decide on the most effective risk management strategy.

Keywords Antibiotic Resistance; Zoonoses; Food-Borne Pathogens; Veterinary Antimicrobial Use; Public Health

INTRODUCTION

Antimicrobial agents are used in human and non-human medicine. Non-human use includes applications in food and companion animals, aquaculture, and horticulture. The amount of antimicrobial agents used in non-human medicine in the EU was estimated by the European Federation of Animal Health as 35% of the total usage in 1999 (Shryock 2003). Non-animal agricultural applications are negligible in comparison to animal usage. Applications in aquaculture are frequent but detailed data on amounts used are not available. Usage of antimicrobials in animals, as in every other application, can result in selection of resistant bacterial populations. This can, in the case of food animals, result in contamination of food products with resistant pathogens, which is why this application deserves attention with respect to resistant bacteria in humans.

Resistance developing in potential human pathogens can contribute to illness when these pathogens reach the human host in sufficient amounts to cause infection, and when their resistance interferes with treatment. When resistance develops in non-pathogenic bacteria, these may become donors of resistance genes to pathogens and thus pose an indirect risk to human health. To reduce the problem of human infections caused by resistant bacteria of animal origin, there is continuous pressure to restrict the use of antimicrobials in animals (Angulo et al. 2004). Although this pressure is understandable, it is neither sufficient nor effective in solving the problems of antibiotic resistance in human medicine, as will be discussed in this review.

To weight the positive and negative effects of veterinary antimicrobial use, it is not sufficient to review the evidence of how such usage can result in resistant bacterial populations, that resistant bacteria can enter the food chain, and that particular resistant bacteria are a health threat. It is essential to also take into account the additional routes which lead to resistant bacterial populations, that antimicrobial usage in animals is required for animal health and well-being, that not every resistant pathogen has human health consequences, and that not all resistance-related health effects are of the same magnitude. Moreover, proposed control measures can have unintended adverse consequences.

Reviews are available that treat various sides of the problem. Phillips et al. (2004) listed arguments against blaming veterinary use of antimicrobials for rendering human medication ineffective. Finch (2004) reviewed the problem from the viewpoint of the clinician. Sample bias in surveillance programs (Finch 2004) and bias in the way resistance is expressed as the proportion of total isolates (Schwaber et al. 2004) was covered elsewhere. Reviews blaming veterinary usage of antimicrobials as the cause of food-borne resistant pathogens are also available (Angulo et al. 2004; Mølbak 2004). However, these pathogens are estimated to be less than 4% of the resistant bacterial population causing problems to human health (Bywater & Casewell 2000).

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