THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
April, 2023; 3(04), 514-518

Popular Article

Antimicrobial resistance in Veterinary Medicine and its effects

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https://doi.org/10.5281/zenodo.7833915

Abstract

The present literature describes about the over use of antimicrobial drugs, development and spread of antimicrobial resistance (AMR), multi drug resistance which has adverse effects on animal as well as public health care systems. This is a global challenge not only pertaining to antimicrobial residues in food animals but also can cause huge economic losses to livestock, mankind, agriculture and the ecosystem, its effect on morbidity and mortality in both man and animals and challenges faced by both human and veterinary medicine. Monitoring initiatives, policies and strategies should be developed and implemented in obstruction of antimicrobial resistance by local bodies, national and international authorities.

Introduction

Antimicrobial resistance is one of the major public health issues of this era which poses a threat to health care systems. It has been showing significant interference in effective prevention and treatment of an ever-growing number of pathogenic infections such as bacterial, viral, fungal and parasitic infections which are no longer susceptible to previously used conventional medications (Prestinaci *et al*., 2015). Multidrug resistance is defined as resistance of a microorganism to the administered antimicrobial medicines despite their earlier sensitivity to it. Multidrug resistance (MDR) microbes are sometimes referred to as superbugs because they are immune to numerous antimicrobials (Magiorakos *et al.*, 2012).

Development of antimicrobial resistance

Mechanisms of AMR'S are 1) enzymatic inactivation of antimicrobial agents, the enzymes act on antimicrobial agents which metabolizes hydrolytically to inactive end -products .example esterases, which inactivate certain macrolide antimicrobials.2) Mediation of inhibitory effects by antimicrobial agents through modification of targets. This type of drug resistance mechanism also known as target alteration or modification. example- alteration of DNA gyrase often by point mutation which are determinants for Quinolone and Fluoroquinolone resistance. 3) Blocking of antimicrobial target thereby, providing target protection example- protection of tetracycline binding site on the ribosome by small peptides. 4) Reduction in entry of antimicrobial agent into cytoplasm by bacterium, it is referred to as drug permeability reduction hence preventing access of antimicrobial agents to their intracellular drug targets resulting in antimicrobial resistance. example- resistance to Aminoglycosides, Beta lactams, Fluoroquinolones and chloramphenicol. 5) By active efflux of antimicrobial agents from bacterial cell. This mechanism effectively reduces drug concentrations and confers resistance to antimicrobials example- Extrusion of antimicrobial agents from bacterial cell by ATP-binding cassette transporters through the use of biological energy of ATP hydrolysis. (Lekshmi *et al.*, 2017).

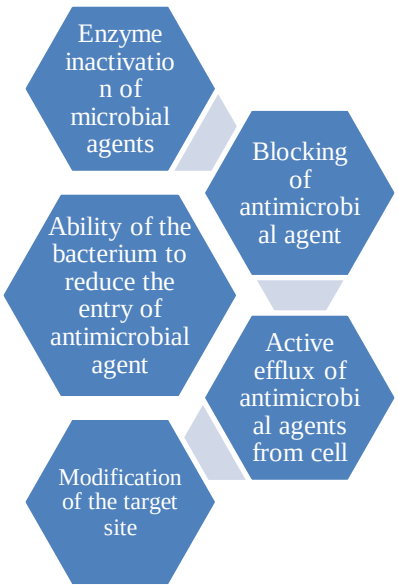

Fig 1.1: Depicts of Development of antimicrobial resistance Through various mechanisms

Types of antimicrobial resistance

Antimicrobial resistance is of two types: Natural resistance and Acquired resistance.

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Natural Resistance

It may be intrinsic., always expressed in the species or induced (naturally occurring genes in the bacteria, but only expressed to resistance level upon an antibiotic exposure). A trait which is universally shared within a bacterial species, independent of previous antibiotic exposure and in no relation with horizontal gene transfer. Some of the intrinsic resistant bacteria are Listeria monocytogenes to Cephalosporins, Enterococci to Aminoglycosides and Cephalosporins, Anaerobic bacteria to β-Lactams, Aminoglycosides, Quinolones, etc.

Acquired Resistance

It is possible for the bacteria to acquire resistance by acquisition of genetic material through main routes like transformation, conjugation and transposition along with an experience of mutations to its own DNA. The acquisition may be temporary or permanent. Plasmid mediated transmission is most common whereas bacteriophage borne transmission is very rare. Naturally competent bacteria such as Acinetobacter spp are capable of direct acquisition of genetic material from the outside environment. Genes that encode drug targets or drug transporters or regulators that control drug transporters or antibiotic modifying enzyme are most preferentially mutated to aid in antimicrobial resistance (Reygaert, 2018).

Effects of antimicrobial resistance

Having access to powerful antibiotics is essential, and the emergence and spread of resistance that eventually depletes the stockpile of antibiotics will have severe repercussions. Due to pervasive resistance, some antibiotics are no longer advised as first-line options. For instance, since the 1950s, penicillin has been used to treat mastitis brought on by Staphylococcus aureus in cattle. However, due to regionally widespread resistance today, penicillin is no longer an appropriate empirical first option for this indication. (Oliver and Murinda, 2012).

A proven and crucial component of managing infectious diseases is improved hygiene and infection control. Antimicrobial resistance will decrease as general hygiene is improved throughout the entire production process, decreasing the microbial load on food products. A well-established risk management practice is establishing thresholds for the acceptable number of pathogenic bacteria in foods. There are thresholds for a variety of bacterial species or subgroups in foods (e.g., Listeria monocytogenes and E. coli O157:H7). Therefore, setting thresholds for bacteria that are resistant to particular antimicrobials is a viable but rarely used choice to take into account. (Wegener, 2006).

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There are many reasons people keep dogs, pets, and horses. Most people maintain these animals in wealthy neighborhoods for social and sporting purposes. Antibiotics are frequently used to treat skin diseases and urinary tract infections in dogs, as well as skin and reproductive system illnesses in horses. (Bengtsson B and Greko C, 2014). A number of contagious bacterial diseases reduce food production's profitability and wellbeing. Mastitis is a common condition in animals maintained for milk production, primarily cows but also goats, sheep, and buffaloes, and respiratory and enteric diseases are among the most prevalent in many species. (Page and Gautier, 2012). Ambulatory veterinary services or the owner or keeper of the animal are used to inspect and treat animals maintained for food production. Access to and justifications for using antibiotics in food production differ significantly across the globe. (Maron, Smith, Nachman, 2013). Lack of effective illness therapy will cause suffering for the animals and welfare issues, which in turn cause mental stress for the animal attendants (Vaarten, 2012). Trimethoprim-sulphonamide has been regionally replaced as a useful first line of treatment due to resistance in Escherichia coli that causes enteritis in young pigs (Aarestrup, Oliver Duran, Burch. 2008).

Impact of biofilms in antimicrobial resistance

Development of Biofilms takes place when microorganisms associate with and adhere to submerged surfaces. Pathogens among the wide range of bacteria that form biofilms provide a mechanism for these organisms to defend themselves from antimicrobial agents. Mechanisms that defend antimicrobials are Delayed Penetration of the Antimicrobial agent, Alteration of the Cellular Growth Rate and association of bacteria with a surface during biofilm formation caused a number of physiologic responses as a result of the repression or induction of genes (Donlan and Rodney, 2000).

Conclusion

In both human and veterinary health, the effects of microbial resistance to antimicrobials are essentially the same. The increased expense of medical care for people and animals will have an impact on the economy. Although resistance primarily has negative effects, the realization of the seriousness of the issue and the attention given to these problems by the scientific community and the media also have positive effects. The emergence of resistance has served as motivation for the creation, assessment, and adaptation of alternative therapy or prevention regimes. Monitoring initiatives, policies and strategies in obstruction of antimicrobial resistance should be taken up by local bodies, national and international authorities for the welfare of animals and mankind.

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