

## WHAT IS ANTIMICROBIAL RESISTANCE?

### Gérard Moulin

French Agency for Food, Environmental and Occupational Health and Safety (Anses), National Agency for Veterinary Medicinal Products, 8 rue Claude Bourgelat – Parc d'Activités de la Grande Marche, Javené BP 90203, 35302 Fougères Cedex, France

In order to understand antimicrobial resistance, there is the need to get first an insight into the fascinating world of Bacteria. These microscopic organisms are present everywhere.

Bacteria can adapt to very extreme conditions and can survive to extreme conditions (heat, cold, radioactivity). The adaptability capacity of bacteria is linked to their ability to multiply very rapidly and to exchange easily genetic material. Knowing the characteristics of these microorganisms, the development by bacteria of resistance to antibiotics is not surprising.

Antibiotics are substances that can kill or inhibit the growth of bacteria; they can be found in nature and can be produced by microorganisms. In the ecosystem, resistance to antibiotics can be seen as a protection mechanism that some bacteria have developed to be able to survive to antibiotics *produced* by other bacteria or microorganisms. Antimicrobial resistance is not a new phenomenon and resistant bacteria were present on earth for many thousand of years.

The use of antibiotics in human medicine started in the 1940's and first difficulties to treat infections due to resistance appear in the late 1950's. This illustrates the adaptability properties of bacteria to the antibiotic selection pressure.

In a bacterial population in contact with an antibiotic, sensitive bacteria will be destroyed while resistant bacteria will survive and develop. Therefore any use of antimicrobial will lead to the selection of resistant bacteria. Resistance can occur from different biochemical mechanisms, it can be for example active efflux, reduced permeability, inactivation of the antibiotic by enzymes, alteration of the target of the antibiotic.

The most frequent mechanism governing the acquisition of antibiotic resistance by a bacterial cell is the occurrence of horizontal gene transfer (HGT) between a resistant bacterial cell and a susceptible one. Environmental ecosystems and the gut microbiome (human or animal) are privileged places for HGT. Bacterial cells may exchange genes by three mechanisms (transduction, transformation, conjugation).

Genetic material such as plasmid can contain multiple resistance genes and then confer to the receptive bacteria resistance to more than one antibiotic and also virulence factors. Therefore the use of a specific antibiotic may select resistance to other antibiotics.

Understanding the bacterial world is essential to realise that fighting against antimicrobial resistance is not a simple issue and that no single evident solution exists.

Prudent use of antibiotics in all sectors by all stakeholders should be the rule to control and limit resistance and preserve tools for treating bacterial diseases.

