Antibiotic resistance: its significance and impacts on health management

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Definition

- “resistant strain” : ability to function, survive, or persist in the presence of higher concentrations of an antimicrobial agent than the members of the parental population from which it emerged, or than other species respectively.

Antibiotic resistance

- One of the major public health problems (WHO)
- International spread of microorganisms
- It is a global problem and requires a common strategy
- Severe implications on the treatment of both animal and human infections

Antibiotic resistance

- Difference between antibiotic residues and antibiotic resistance
- All antimicrobial drugs can select microorganisms that are resistant
- Resistance determinants could be maintained within the bacterial population even in the absence of the corresponding antibiotic

Antibiotic resistance

- Interaction between different ecological systems

- Potential transfer of resistant bacteria or resistant genes from animal to human bacteria may occur through the food chain

Antibiotics abuse

- Small-scale farmers
- Low technical knowledge
- Open market
- Wide range of commercial products
- Quality guaranty
- Insufficient health support and diagnosis services

Antibiotics abuse

- Under-regulation or insufficient enforcement
- Excessive and inappropriate use of antimicrobials
- Prophylactic use, growth promoter

Resistant pathogens

- According to the Centres for Disease Control and Prevention (USA), resistant strains of three major human pathogens – *Salmonella* sp., *Campylobacter* sp. and *Escherichia coli* – are linked to the use of antibiotics in animals.

Resistant pathogens

- *Salmonella enterica* DT104, resistant to five drugs including ampicillin, chloramphenicol, streptomycin, sulfonamides, and tetracycline
- *flo*$_{st}$ gene mediating resistance to chloramphenicol, confers also resistance to florfenicol
- Using florfenicol might compromise use of chloramphenicol in treating the infection

Bacterial resistance

- Adaptation of bacteria to fluctuating antibiotic environment
- Multipurpose or multiple mechanisms of survival
- Associated-resistance mechanisms
- Particular resistance profiles without a direct use of the corresponding drugs by the farmer

Bacterial adaptation

In response to a fluctuating antibiotic environment bacteria optimises its resistance system towards multiple drugs to survive

Bacterial resistance

- Multi-efflux pumps in *E.coli* (AcrAB efflux system) for TE, C, AM, NA
- Expression of an outer membrane protein (OMP54) in *Stenotrophomonas maltophila* was associated with an increase of the MIC for TE, C and quinolones

Bacterial resistance

- Intrinsic resistance:

  enzymes (ß –lactamase)

  impermeability of the membrane

  absence of the target in the cell
- Acquired resistance

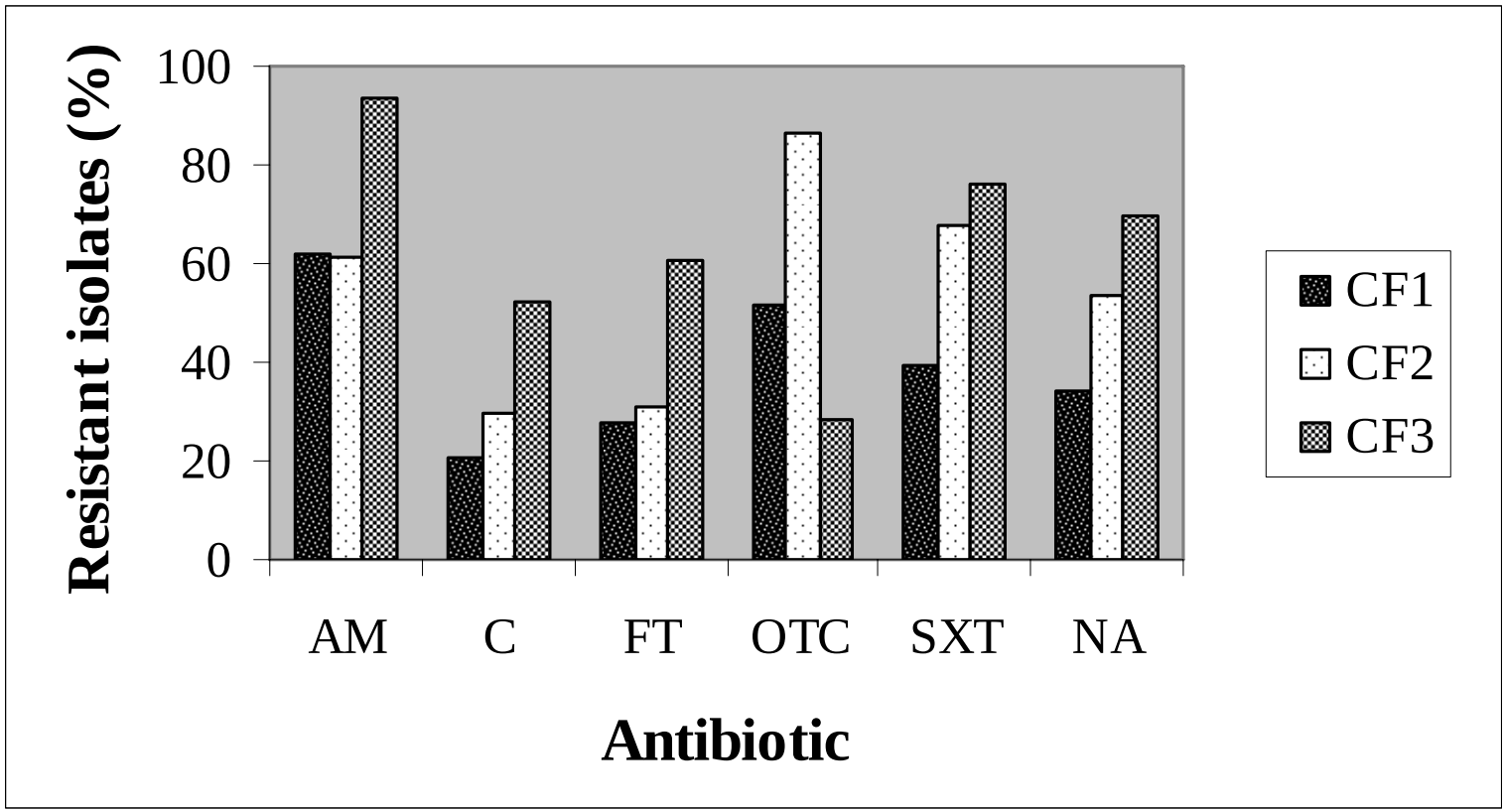
Bacterial resistance

- Mobile genetic elements encoding for resistance : plasmids , transposons, integrons
- New gene combination
- Important role in horizontal transfer and spread of resistance

Impacts

- Contamination of the environment with bacterial pathogens resistant to antimicrobial agents is a real threat not only as a source of disease but also as a source from which resistance genes can easily spread to other pathogens of diverse origins.

Sarter S., H.N.K.Nguyen, L.T. Hung, J.Lazard, D.Montet. Antibiotic resistance in Gram-negative bacteria isolated from farmed catfish. Food control 2007, 18, 1391–1396



Recommendations

- Resistance monitoring and surveillance
- Therapeutic purposes (sensitivity patterns)
- Avoid broad spectrum molecules
- Reduce the spread of infections using disease prevention strategies and by improving the animal husbandry
- Proper utilisation: dosage, duration, withdrawal periods