Antimicrobial use in poultry: Emerging public health problem

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Antibiotics

- Natural or synthetic drugs which inhibit or kill bacteria or fungus.
- Modes of action of antibiotics
  - Inhibition of nucleic acid synthesis
    - i) Fluoroquinolones (e.g. enrofloxacin, norfloxacin etc)
    - ii) Rifampin
  - Inhibition of metabolic pathways
    - (e.g. Sulfonamide/Trimethoprim)
- Disruption of cell membrane
  (e.g. Polymixins & daptomycin)
- Inhibition of protein synthesis
  (e.g. OTC. aminoglycosides (e.g. streptomycin), chloramphenicol)

**What are the main uses of antimicrobials in poultry?**

1. Specific therapy against known bacteria infections
2. Prophylaxis – e.g. poor hygiene environment
Undesirable effects of AB

* Rationale usage
  - Antimicrobial agent preparations use in Kenya is not controlled
  - Usage should be restricted to specific therapy after confirmatory diagnosis of the underlying bacterial infection
  - Prophylaxis usage should be discouraged at all times

* What is antimicrobial resistance?
  - This is the ability of bacteria to survive exposure to one or more antimicrobials to which they would normally be susceptible.
  - The gains in the use of antimicrobials is under threat due to frequent emerging resistance of cheap and effective ‘first choice or first line’ drugs.
* Sequalae of increased AMR
  * - Delays in clinical recovery by patients (prolonged illness).
  * - Increased cost in therapy
  * - Greater risks of death or loss of production
    * - Alternative AB not available and more resources for research in new antimicrobial agents
  
* How do bacteria become resistant to antibiotics?
  * i) Natural – e.g. *E. coli* is resistant to penicillin
  * ii) Acquired resistance – due to *de novo* mutation or acquisition of resistance genes from other bacteria

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Usage of antimicrobials in food animals in Kenya (Adapted from Mitema et al 2001)

**AB Consumption**

- Large Animals = 75%
- Poultry = 20%
- Large animals + Poultry = 5%
What are the mechanisms of acquired resistance?
- Bacteria produces enzymes that destroy antimicrobials
- Bacteria expresses efflux system that prevent antibiotic from reaching its intracellular target
- Bacteria modifies the drug’s target site
- Drug undergoes an alternative metabolic pathway
  by bacteria

How do bacteria acquire new genetic material?
- Conjugation (mating)
- Transformation
  - Transduction
    - Acquisition of mobile genetic elements like transposons, integrons or gene cassettes
Where are the resistant genes located?
- Bacterial chromosomal DNA
- Plasmids (extra chromosomal DNA)

Why has antimicrobial resistance become an emerging issue?
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<thead>
<tr>
<th>Antimicrobial agent</th>
<th>Discovery</th>
<th>Clinical use</th>
<th>AR dev</th>
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<tbody>
<tr>
<td>Penicillin</td>
<td>1940</td>
<td>1943</td>
<td>1940</td>
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<tr>
<td>Streptomycin</td>
<td>1944</td>
<td>1947</td>
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<td>Tetracycline</td>
<td>1948</td>
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<td>Erythromycin</td>
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<td>Vancomycin</td>
<td>1956</td>
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<td>1987</td>
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<td>Nalidixic acid</td>
<td>1960</td>
<td>1962</td>
<td>1966</td>
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<td>Gentamicin</td>
<td>1963</td>
<td>1967</td>
<td>1970</td>
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<td>Fluoroquinolones</td>
<td>1978</td>
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Adapted from Schwarz and Chaslus-Dancla(2001)
AMR by itself is not new, however the rate of increase is alarming compared to the world’s ability to contain it or have new antimicrobial drugs. There is a dramatic upsurge in the spread of drug-resistant microbes. AMR has thus become a “public health issue worldwide.” Bacteria that are resistant to antimicrobials pose a threat to both human and animal health. Essential life-saving antibiotics or Critically Important Antibiotics (CIA) (e.g. fluoroquinolones, 3rd and 4th generation cephalosporins) become less effective against bacteria resulting in fewer alternatives available for successful treatment of bacterial infections.
The misuse and overuse of antibiotics has reduced many cheap and common types ineffective against some bacteria.

Failures in clinical efficacy by antibiotics may lead to:

i) Prolonged illness – death and loss of production

ii) Switching to second or third line drugs which are always much more expensive and sometimes much toxic.

Current trend of AMR development suggests that some bacterial infections will have no effective therapy within the next ten years.
Why is AMR important in food animal production?

Antibiotic use

- Human medicine - Contributes to over 70% use
- Veterinary medicine (food animals, fish) – less than 25%
- Agronomic usage – less than 3%

* Recent studies have implicated the rise in resistance of these bacteria to increased use of antibiotics in veterinary medicine and agriculture.
What factors are likely to contribute to over usage of antimicrobials agents in poultry production?

1. Lack of adequate knowledge on AMR by some cadre of livestock personnel
2. Empirical therapy based on clinical investigations rather than isolation, typing and of the pathogen
3. Availability of antibiotics over the counter
4. Insufficient regulatory and poor law enforcement
5. Industry may influence prescription patterns of some antibiotics
Several studies have demonstrated association between the use of antimicrobials in food animals and development of resistance e.g., Fluoroquinolone resistant Salmonella and Campylobacter from animals and humans following use of fluoroquinolone in poultry.

- FDA banned use of fluoroquinolone in poultry in 2002
- In Kenya, reports have shown a correlation of antimicrobial use and resistance development
- VRE was shown to be due to the use of avoparcin as a growth promotant in animals in Europe. This has not been reported in Kenya since growth promoters are not marketed in the country.


Fig I: Mean antimicrobial consumption (kg) per year in food producing animals in Kenya during the 1995 to 1999 period (Mitema et al. 2001)
Fig 2: Mean human antimicrobial usage in Kenya during 1997-2001 period

Antimicrobial class

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Current on going AMR investigations

* 1. Enterococcus spp phenotype and genotype resistance to commonly used antibiotics - Vancomycin, Erythromycin etc
* 2. MRSA and MRSP in dogs
What is the way forward and recommendation

1. Prudent use of antimicrobial drugs in livestock production including poultry
2. Programmes to monitor the occurrence and development of antimicrobial resistance are highly desirable in Kenya and other countries
3. Effective infection control and hygienic practices should be implemented in poultry production management systems
4. Use of life-saving antimicrobial agents (3rd, 4th generation fluoroquinolones and cephalosporins) should be only after antimicrobial susceptibility tests (AST).
Thank you

*Q and A*