Integrated Study of Food borne Antimicrobial Resistance (AMR) in Kenya

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Outline

1. Introduction
2. Study scope and Objectives
3. Study design and Sampling
4. Methodology
5. Provisional Results
6. Follow-up activities, outputs/outcomes
“Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food” [FAO World Food Summit, 1996]

Food Safety is key to health and nutrition = the ultimate goals of Food Security
Strategic Framework and Context

FAO Mandate/mission

Animal production and Health Division

**Strategic Objective:**
INCREASED SUSTAINABLE LIVESTOCK PRODUCTION

- Livestock sector effectively and efficiently contributes to food security, poverty alleviation and economic development
- Reduced Animal disease and associated human health risks
- Better management of natural resources, including animal genetic resources in livestock production
- Policy and practice for guiding the livestock sector are based on timely and reliable information

Support to veterinary public health systems and services
FAO AMR objectives

- Promote prudent and responsible use of antimicrobial drugs: support livelihoods of livestock owners and economies; and minimize human health risks;

- Support national/regional capacities to manage AMR risks – at all stages of the food chain;

- Collaboration with international partners, esp. WHO and OIE in development of tools/guidelines and contribute to standards setting functions.
AMR pathways: exposure and spread
Integrated Program for Antimicrobial Resistance Surveillance (CIPARS)

Epidemiology of Antimicrobial Resistance

Food Animals
- Sheep
- Cattle
- Veal Calves
- Other Farmed Livestock
- Poultry

Companion Animals

Agriculture
- Farm Effluents and Manure Spreading
- Rendered Animal Feeds

Livestock
- Dead stock
- Offal

Processing Plants
- Commercial Abattoirs
- Meat

Environment
- Soil
- Wild Life
- Aquaculture
- Rivers and Streams
- Sea / Lakes
- Drinking Water

Industrial 
- Household Antibacterial Chemicals

Human Health
- Hospitalized
- Community Urban - Rural
- Extended Care Facilities

Handling Preparation Consumption

Direct Contact

after Linton AH (1977), modified by Irwin RJ
Usage of veterinary antimicrobials
Overall Objective of Kenya study

To undertake a baseline *integrated* prevalence study of food pathogen contamination and antimicrobial resistance in farm animals, abattoirs and retail meat outlets - as well as from human clinical specimens in selected sites in Kenya.

- FAO /WHO Collaboration
- Implementing partner: *Kenya Medical Research Institute (KEMRI)*
Specific Objectives

1. To determine the prevalence of *Salmonella* spp, *Campylobacter* spp, *E. coli* and *Enterococcus* spp in food animals, carcasses and retail meats as well as from human clinical specimens in selected regions in Kenya - *ongoing*.

2. To determine the antimicrobial susceptibility patterns of these foodborne pathogens to commonly available classes of antimicrobials - *ongoing*.

3. To investigate *in-vitro* transferability of antibiotic resistance determinants in *E. coli* and *Enterococcus* spp (indicator organisms) isolated from animals and meat products – *pending*.

4. Beef/Poultry/(Pig) Value Chain Assessments
   - value chain assessment, review of national food safety information/data and analysis of food safety institutional framework - *completed*.
Study sites

1. **Nairobi and Thika County** – farms, main public abattoirs run by the City and municipal authorities and meat outlets served by these abattoirs

2. **Nyanza**: abattoirs, farms and outlets in Kisumu, Maseno and Kakamega

3. **Coast**: slaughter houses, farms and outlets in Mombasa, Kwale and Malindi

Differences in:
- size,
- rural/urban,
- production systems,
- management and hygiene standards
Study Design and Methods

**Sampling**
- Farms
  - Droppings
  - Animal feeds
  - Cloacal swabs
- Animal Slaughter Establishments
  - Carcass swabs/Neck skin
  - Rectal swabs
  - Lymph nodes
  - Effluent
  - Ingesta
- Retail
  - Retail meat
  - Neck skin/poultry
  - Carcass swabs
- Human stool

**Sample Handling/Processing**
- Transport
- Pre-enrichment
- Enrichment
- Isolation
- Antimicrobial susceptibility testing
- Tetracyclines, chloramphenicol, sulphonamides, β-lactams and quinolones

**Questionnaires**
- Value Chain actors: Feed Producers, Farmers, Abattoir Operators, meat retailers, pharmaceutical supplies, Agro-vet suppliers, etc.

**Value Chain Analysis**
- Poultry
  - Policy/Regulatory Agencies
  - Pre-enrichment
  - Types of production systems
    - Structure
    - Linkages
    - Inter-relationships, etc.

**Assessment of Policy, Institutional, Legislative Framework**
- Agedness of existing food safety policies and legislation
- Identification of institutions, their roles and inter-relationships
- Identification of gaps and overlaps
- Guidance and recommendations
Sampling

- **Feed Producers**
  - *Animal Feeds*

- **Farms**
  - *Animal feeds*
  - *Cloacal/rectal swabs*
  - *Droppings*

- **Animal Slaughter Establishments**
  - *Carcase swabs/Neck skin*
  - *Ingesta/intestinal contents*
  - *Lymph nodes*
  - *Effluent*

- **Retail**

- **Clinical specimens**

*Experts Panel advice on sampling and study methodology*
Laboratory procedures: *isolation & enumeration*

- **Isolation:** Enrichment, selective enrichment, biochemical tests and Gram stain for identification:
  - *Salmonella* spp
  - *E. coli*
  - *Enterococcus* spp
  - *Campylobacter* spp

- **Enumeration of total E. coli and coliform counts by 3M Petrifilm plate method**
Antibiotic susceptibility Tests

Antibiotic Susceptibility Tests – Kirby-Bauer Disk diffusion Technique (Bauer et al. 1966)

- **β-lactams**
  - Ampicillin
  - Co-Amoxiclav
  - Ceftriaxone
  - Cefotacime

- **Tetracycline**

- **Quinolones**
  - Nalidixic acid
  - Ciprofloxin

- **Aminoglycosides**
  - Gentamycin
  - Streptomycin
  - Kanamycin

**Campylobacter spp.** Isolates – all tested for susceptibility to Erythromycin, tetracycline and ciprofloxin (agar dilution method)
<table>
<thead>
<tr>
<th>Type of animal sampled</th>
<th>Total no. of specimen sampled</th>
<th>Type and total no. of bacteria isolated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pig</td>
<td>69</td>
<td>48 E. coli, 1 Citrobacter spp., 2 Klebsiella spp.</td>
</tr>
<tr>
<td>Chicken feeds</td>
<td>75</td>
<td>64 E. coli, 7 Enterococcus spp</td>
</tr>
</tbody>
</table>
Beef Isolates: Antibiotic susceptibility patterns for *E.coli*

- Streptomycin
- Ceftriaxone
- Gentamycin
- Chloramphenicol
- Nalidixic acid
- Ciprofloxacin
- Tetracycline
- Augmentin
- Kanamycin
- Co-Ttrimoxazole
- Ampicillin

Sensitive
Intermediate susceptibility
Resistant

N = 297
Poultry Isolates: Antibiotic susceptibility patterns for *E. coli* isolates

- **SXT**: Co-Ttrimoxazole
- **AMP**: Ampicillin
- **CRO**: Ceftriaxone
- **GM**: Gentamycin
- **C**: Chloramphenicol
- **NA**: Nalidixic acid
- **CIP**: Ciprofloxacin
- **TE**: Tetracycline
- **AMC**: Augmentin
- **K**: Kanamycin

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Sensitive</th>
<th>Intermediate</th>
<th>Resistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST - Streptomycin</td>
<td>70%</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>CRO - Ceftriaxone</td>
<td>70%</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>GM - Gentamycin</td>
<td>60%</td>
<td>10%</td>
<td>30%</td>
</tr>
<tr>
<td>C - Chloramphenicol</td>
<td>70%</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>NA - Nalidixic acid</td>
<td>60%</td>
<td>10%</td>
<td>30%</td>
</tr>
<tr>
<td>CIP - Ciprofloxacin</td>
<td>70%</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>TE - Tetracycline</td>
<td>50%</td>
<td>20%</td>
<td>30%</td>
</tr>
<tr>
<td>AMC - Augmentin</td>
<td>70%</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>K - Kanamycin</td>
<td>60%</td>
<td>10%</td>
<td>30%</td>
</tr>
<tr>
<td>SXT - Co-Ttrimoxazole</td>
<td>60%</td>
<td>10%</td>
<td>30%</td>
</tr>
<tr>
<td>AMP - Ampicillin</td>
<td>70%</td>
<td>10%</td>
<td>20%</td>
</tr>
</tbody>
</table>

N = 410
Prioritization of interventions

Codex Guideline for Risk Analysis of Food borne AMR (CAC/GL-2011)
- Risk Assessment
- Risk management
- Surveillance of use of AM agents and AMR organisms and AMR determinants
- AMR Risk Communication

High
- Tetracyclines; Co-Ttrimoxazole and Ampicillin

Medium
- Streptomycin, Chloramphenicol, Nalidixic acid and Ceftriaxone

Low
- Augmentin, Kanamycin, Ciproflaxin and Gentamycin
Follow-up activities and outputs/outcomes

1. Regional Technical Meeting (August 2011): to review preliminary results and discuss follow-up actions in context of regional harmonization;

2. Support development and implementation of national/regional programmes on surveillance of use of antimicrobial agents, and AMR;

3. Other collaborative projects - *replication of initiative in other developing countries*;

4. Development guidance and support implementation:
   - *Policy*
   - *Prudent use of antimicrobials in animal production*
   - *Risk-based hygiene controls in abattoirs*
Thank You
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