Antibacterial Use in the Modern Poultry Industry and Control Mechanisms that Affect Bacterial Resistance Development

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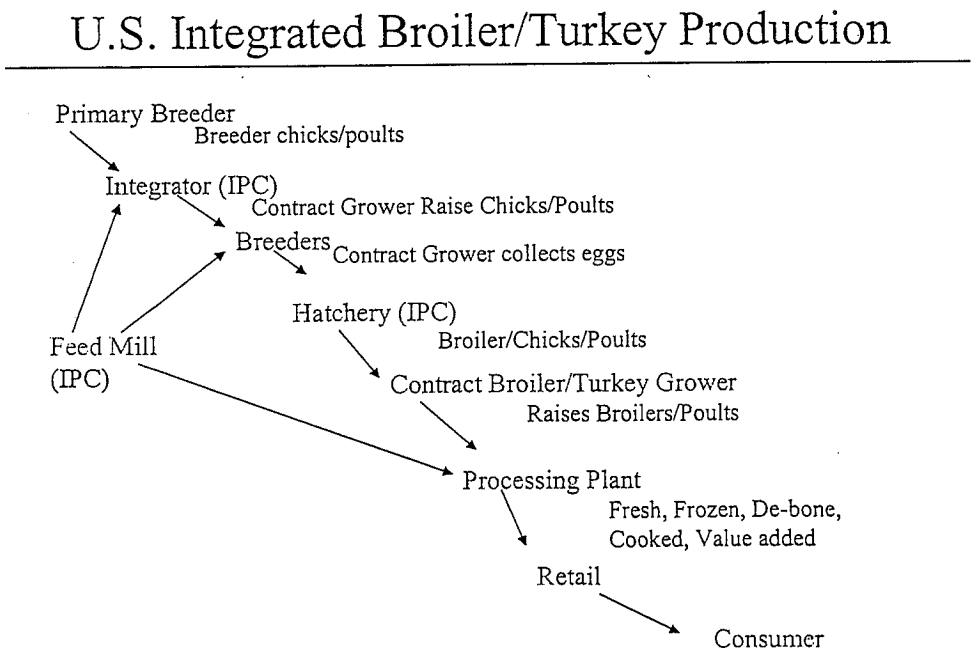
Introduction

The intended purpose of this paper is to describe how antibacterials are used in today's poultry industry. This discussion must clearly explain the structure of the industry, the number and type of animals therein, those decision maker health professionals who work in and operate the system and their relative level of expertise. It should also describe how decisions are made and what science-based tools are used to insure that the outcome of the system, i.e. protein products, is safe, wholesome and that there are no dangerous ecosystem threats resulting from the process.

Structure of the Industry

The poultry industry in this country is made up of four basic components and their respective integrated or related parts: broilers, turkeys, eggs, and gamebirds and/or fancy fowl. Vertical integration/contract growing is the most common business strategy employed where one large company may own nearly every input that is related to the production of the finished product and



can recycle all byproducts in a value added manner. For example, grain procurement, grain drying, transport and storage, soybean processing, feed mills, feed delivery vehicles, breeding stock, hatcheries, chick or poult delivery systems, laboratory system for feed quality/microbiologial assurance/residue detection, service personnel, vaccination crews, catch and livehaul personnel and equipment, processing plant, further processing plant, cooking plant, freezer plant, delivery equipment and logistics, wastewater treatment facilities, and rendering and byproduct recovery plants would all be owned by either a large family corporation or a publicly traded corporation. Economics are the controlling factor in most decisions as costs are measured in hundredths of cents per pound.

The Resident Health Professional

Within these modern companies there exists a system that ensures the health and welfare of animals, man, and the environment. An important part of this system is a highly trained, well-connected, deeply informed professional who is responsible for much. Usually this is a licensed, advance degreed, board certified specialist in avian medicine. The avian medicine veterinarian must be trained in preventive medicine, epidemiology, immunology, live production methods/microeconomics and husbandry, microbiology and therapeutics, processing plant methods, USDA/FSIS requirements and best management practices, i.e. HACCP, and entomology. The practice of avian medicine is their sole practice. Most are full time employees of these large integrated companies. There are roughly one hundred and fifty of these specialists. There are just as crucial to their companies as the company's brand. Why? Because much of what they manage can influence the integrity of the brand. The issues loom large: food safety, animal welfare, microbiological quality, drug resistant zoonotic organisms, and the purity of water and air. In the context of this symposium these are the people who manage the drugs used in the system and the resistance monitoring that safeguards human health.

Types and Strategies of Drug Use

Three distinct methodologies are possible for antimicrobial drug use in food animal poultry medicine. Growth promotion using nonsystemic drugs, therapeutic drugs which usually by the nature of the disease means systemic drugs, and lastly growth promotion or prevention methods using subtherapeutic levels of systemic drugs. The latter, although FDA approvals do exist, is almost never utilized in the modern poultry system except where no approved drug exists for therapy of that disease which is being prevented.

Antibiotic Use in Poultry (U.S.)

Three Categories:

I) *Continuous-fed Growth Promotants

1) Bacitracin
2) Virginiamycin
3) Bambermycin
4) Lincomycin
5) Tylosin (in special cases)

*Typical animal receives these drugs in 50% of diet.

II) Therapeutic

1) Day old or egg injection (Embrex)

- Gentamicin - Ceftiofur (Rx) - Sarafloxacin (Rx)

2) Via water (OTC and Rx)

- Tetracyclines - Sulfas -Lincomycin (L) - Penicillin
- Bacitracin - Tylosin - (L) + Spectinomycin
- Erythromycin - Sarafloxacin (Rx) - Enrofloxacin (Rx)

3) Via Feed (OTC only)

- Tetracycline - Sulfadimethoxine - ormetoprim
- Novobiocin - Tylosin -Neomycin-oxytetracycline

III) Sub-therapeutic (feed only)

Performance Enhancement, Preventative, Stress-reduction

- Tetracyclines
- Tylosin
- Penicillin

The past three FDA approval (ceftiofur, sarafloxacin, enrofloxacin) have required veterinary prescription. Sarafloxacin and enrofloxacin also require **resistance monitoring.**

Systemic Drugs NonSystemic Drugs

- Oxytetracyclines
- Chlortetracyclines
- Penicillin
- Sulfadimethoxine/ ormetoprim
- Tylosin
- Erythromycin
- Fluoroquinolones

- Bacitracin
- Bambermycins
- Neomycin
- Virginiamycin

- Lincomycin

Indiscriminate Options:

Worst Case - Use of systemic drugs at subtherapeutic levels.

Production Level -- How Medication Is Used

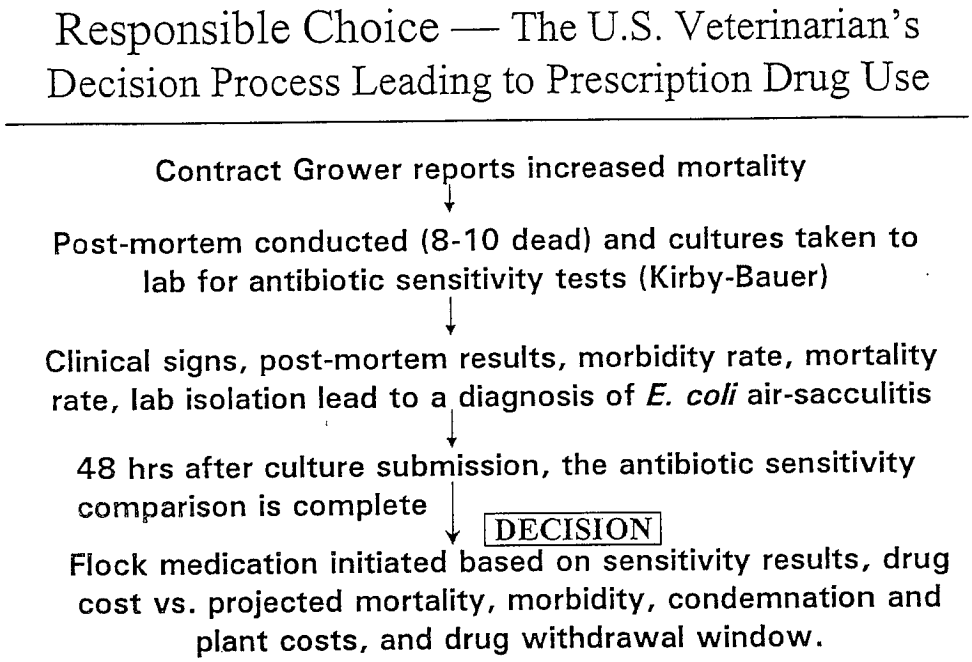
(1) Primary Breeding - selective, judicious, targeted for disease eradication. MM, MI, *S. arizonae*

(2) Multiplier Breeding - enhance performance of breeding stock and prevent mortality and morbidity. Prevent vertical transmissions.

(3) Commercials - Three strategies employed :

Growth Promoting (feed)	**Therapeutic/OTC** (feed and water)	**Prescription Therapeutic**
Examples:	Examples:	Examples:
Bacitracin	Tetracycline	Ceftiofur (inj. only)
Bambermycins	Penicillin	Sarafloxacin (inj, water)
Virginiamycin	Sulfas	Enrofloxacin (water only)
Lincomycin		
Tylosin		

The veterinarian's decision process leading to the use of antimicrobials is presented below:



Routine Diagnostic Microbiology and Antibiogram Use

The routine poultry use of these two scientific methods likely ranks first among all health fields. The Oakwood Poultry Laboratory which is part of the Georgia Poultry Laboratory System data show that in 56.2% of cases diagnostic microbiology was employed. One cannot recall any other field where the incidence is this high. The case accessions from this large poultry laboratory are categorized below. Even though a large percentage of cases involve fixed tissue or serum submissions one can see that poultry medicine relies heavily upon routine culture and antibiograms.

Georgia Poultry Laboratory
Oakwood, GA

JANUARY - NOVEMBER, 1997

Total Poultry Case Submissions	16,714 (includes fixed tissue and serum submissions)
Bacteriology Done	9,398 (56.2 % of total)
*Susceptibility testing done	3,930 (23.5 % of total)

*Antibacterial Susceptibility testing not done routinely for chick quality checks (yolk-sac cultures), on plates where no growth occurred, or on salmonella isolates.

Control Mechanisms

The various control mechanisms employed in prescription antimicrobial drug use are discussed.

Control of Procurement and Use Records in Rx Poultry Drugs

- Prescribing vet's license number verified prior to processing of order
- Detailed record of Rx mailed to vet monthly
- Vets also keep in-house records and inventory log
- Cost-benefit analysis done by prescribing vet on every Rx; must justify cost of treatment to grower and IPC must see dramatic response to therapy, therefore must have proper diagnosis and sensitivity results.

Commitment to Responsible Choice

- Eight state labs across the U.S. are susceptibility testing *E. coli* field case isolates for enrofloxacin, sarafloxacin, and other antibiotics at manufacturer's request (several thousand samples per year), to detect changes in resistance patterns.
- Support the message: *Proper dose, duration, and diagnosis will preserve FQ's as the most efficacious therapy in Poultry for years to come.*

A list of actions that could induce or result in drug resistant microbes in poultry and ways to minimize them are included here.

How to Create Resistance in Potential Human Pathogens/Zoonotic Diseases

1. Poor drug pharmocokinetics
2. Under dose - partial dosing
3. Under duration
4. Low cost of drug
5. Widely available, i.e. over the counter
6. Used in feed for healthy and sick
7. Use for growth promotion
8. Used up and down the production chain

9. No resistance monitoring program
10. Wrong drug choice for offending organism
11. Unscrupulous methodology
    - Counterfeits [containing other FQs (unabsorbed)]
    - Unlicensed products
    - Poor drug potency/purity
12. No vaccination control of disease
13. No biosecurity programs
14. Highly profitable meat business where cost is no object.
15. No vector control
16. Lack of processing controls

Future Study

If we are to truly evaluate the system of antimicrobial use in poultry and the potential of its use for spread of resistant zoonotic organisms to man then we should look at the interface of man and animal for sentinels to study. First time contract growers or bird handling personnel should be studied for types and incidence of disease, organisms which can be recovered, host adaptiveness of non-human organisms, resistant markers and the potential pathogenesis and immunity that may ensue. Resident alien workers in processing facilities who frequently travel to their homelands should also be examined for pathogens and resistant forms.

Practices that Reduce Resistance Development

- Do not inject a therapeutic antimicrobial at day-of-age (sub-therapeutic) across broad populations over long periods of time.
- Do not "shot-gun" therapy without a diagnosis supported by susceptibility testing.
- Do not treat parent stock, grandparents or elites on a "program" basis. Use a "rifle-shot" coupled with actively managing pathogen and vector control. (Feed, rodents, insects, biosecurity).
- Do not under dose (off label) to save money. Do not shorten the duration of therapy. This encourages the development of resistant bacterial populations.
- Do not combine antimicrobial drugs -- many do not synergize.
- Measure changes in susceptibility to the drugs used over time through culture and sensitivity monitoring.

Summary

If a thorough evaluation of the industry with its health professionals, its current armamentarium and its use of current science, is accomplished it becomes clear that the system of drug use and monitoring for resistant microbes is well controlled, well described, and well governed by the existing regulatory climate and should serve as a model for other health fields.