

Antibiotic Use in Livestock Production

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Presentation Outline

- How are antibiotics used in livestock production
- Quantities used
- Benefits
- Potential Problems

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1. How are antibiotics used in livestock production?

– Therapeutically

- Higher doses, shorter periods
- Used to treat specific diseases

– Subtherapeutically

- Lower doses, longer periods (usually)
- Used to prevent infections, limit subclinical infections, improve growth rates
- Been in practice since the 1950's

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2. Quantities of antibiotics used in livestock production

– Two commonly cited estimates:

- **Animal Health Institute (2000)**

- 18 million pounds used in beef, dairy, swine, and poultry production
- 83% for the treatment of specific diseases

- **Union of Concerned Scientists (2001)**

- 25 million pounds for subtherapeutic uses alone
- 21 million pounds used in swine and poultry production

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3. Benefits of in-feed antibiotic use

- Health improvements: improved gut health, limited subclinical diseases, etc.
- Healthier animals = higher gains
 - increased average daily gain, increased feed efficiency, i.e., more rapid and efficient growth

Production Benefits of Including Antibiotics in Feed

Livestock Species	Growth Rate (%improvement)	Feed Efficiency (%improvement)
Piglets	16	9
Growing Pigs	9	5.5
Broiler Chickens	3-10	3-5
Laying Hens	2	1
Veal Calves	7-10	4-5

Adapted from Avcare 2003

4. Problems associated with using antibiotics in livestock production

1. Antibiotic Resistance

- **FACT:** Administration of an antibiotic in any form usually leads to higher concentrations of antibiotic resistant bacteria among the microflora of the animal
- **THE DEBATE:** Does this pose a risk to human health/medicine? Do the antibiotic resistant organisms that are generated on the farm make their way to human bacterial populations and cause harm?

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4. Problems: antibiotic resistance

- How could on-farm antibiotic resistance affect human health?
 1. Generation of antibiotic resistant foodborne pathogens (*Salmonella*, *Campylobacter*, etc.)
 - Administering an antibiotic to which the bacteria is resistant could result in treatment failure, extended illness, etc. in an infected individual
 - While antibiotics are not routinely prescribed for foodborne illnesses, the drugs are sometimes necessary in severe cases or infections in individuals with compromised immune systems

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4. Problems: antibiotic resistance

- How could on-farm antibiotic resistance affect human health?

2. Spread of resistance genes through commensal or non-pathogenic bacteria

- Easily passed through human populations
- Once established, these organisms could then transfer resistance genes to pathogenic bacteria (Staphylococcus, Streptococcus, etc.)
- Essentially increasing the availability of resistance genes

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4. Problems: antibiotic resistance

- Do these scenarios really occur?
 - No real consensus
 - Some evidence with Avoparcin
 - The complex ecology of bacteria makes drawing conclusions difficult
 - Very difficult to determine the origin of resistance
- Use of antibiotics in human medicine
 - Creates an immediate and large reservoir of antibiotic resistant organisms in the human bacterial population

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4. Problems: antibiotic resistance

- Risk assessment models
 - Predict the impact of resistance developed on the farm on human medicine
 - Based on mathematical models
 - Conflicting results
 - With more models developed there should be a consensus as to which are most accurate; could bring more clarity to the issue

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4. Problems: unabsorbed antibiotics

2. Unabsorbed antibiotics

- The problem:
 - Portions (sometimes large) of the antibiotics are not absorbed by the animal
 - Nonabsorbed antibiotics are excreted in the feces or urine
 - Can be introduced to the environment through manure spreading

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4. Problems: unabsorbed antibiotics

- The effect:
 - Drugs could enter ground or surface water
 - Could kill important soil/water microorganisms
 - Drugs could be taken up by plants
 - Could affect those with antibiotic allergies
 - Could contribute to the development of antibiotic resistance

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4. Problems: unabsorbed antibiotics

- Can the drugs be detected?

Table 1. Concentrations of antibiotics detected in manure, soil, plants, and surface or ground water.

Antibiotic	Manure conc. (mg/kg)	Soil conc. (µg/kg)	half-life (days/environment)	Degradation Rate at 20°C % days		Plant Conc. (species/conc.) ng/g	Surface (S) or ground (G) water conc. (µg/L)	FDA ADI or tolerance
Oxytetracycline	0.82-19.0	<7	47 (sediment)	unknown		not detected	0.07-1.34(S)	25.0µg/kg BW
Tylosin	0.1-7.9	<10	3.3-8.1 (slurry)	100	30	not detected	unknown	0.2ppm
Tetracycline	0.04-24.0	86-172	unknown	unknown		not tested	0.11(S)	25.0µmg/kg BW
Chlortetracycline	0.1-14.0	4.6-7.3	7-20 (manure)	12	30	2.0-17.0	0.15(S)	25.0µmg/kg BW
amprolium	0.0-77.0	unknown	unknown	30	90	not tested	unknown	0.5ppm±
sulfamethazine	0.13-8.7	unknown	50-100*(sediment)	unknown		not detected*	0.076-0.22 ^a (G)	0.1ppm
sulfathiazole	traces-12.4	unknown	50-100*(sediment)	unknown		not detected*	0.08 ^b (G)	0.1ppm

®ADI = acceptable daily intake; *value for sulfadiazine; BW = body weight; ^a = 0.076 -0.22ppb; ^b = 0.08ppb; †value for monensin; ± = lowest FDA tolerance level for amprolium

Ebner 2007

At each step there is a significant drop in the amount of active antibiotic—concentrations in end sources are usually much lower (100-1000 fold) than FDA acceptable daily intake levels

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Summary

- Antibiotics are used in livestock production both therapeutically and subtherapeutically
- In-feed antibiotics improve animal health which translates to more rapid and efficient growth
- Concerns over using antibiotics in livestock production center around the development of antibiotic resistance and the fate of unabsorbed antibiotics
- The use of antibiotics in livestock production does lead to increased levels of antibiotic resistance, but it is unclear as to how much this affects human health
- Improved risk assessments may tell us what actions, if any, should be taken to continually produce safe meat, dairy, and poultry products

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Summary

- Active unabsorbed antibiotics can be detected around livestock operations
- New research shows that some plants can take up very small amounts of antibiotics from contaminated soil
- Tracing the fate of antibiotics from manure to end sources indicates that the concentrations of the drugs drop significantly at each remediation step
- Concentrations at end sources are usually much lower than FDA acceptable daily intake concentrations

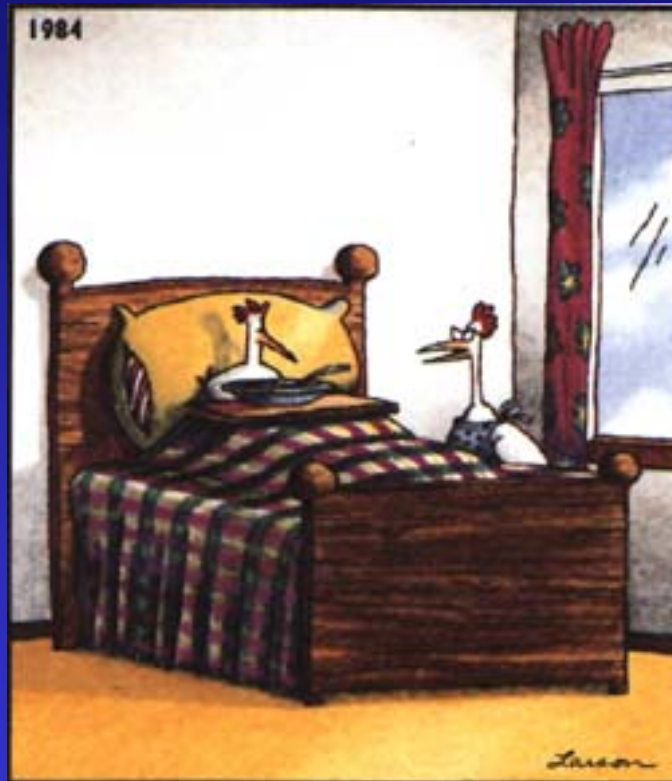
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Antibiotics in livestock production

- Questions?



"Quit complaining and eat it! ... Number one, chicken soup is good for the flu—and number two, it's nobody we know."

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