History and How Antibiotics Function to Improve Animal Health

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Learning objectives

• Appreciate the history of the development of antibiotics including how recent it is and its large impact on human and animal health

• Understand how antibiotics function to improve animal health

• Appreciate the limitations of antibiotics to compensate for poor animal health and management
History of Antibiotics

• Sir Alexander Fleming
  • 1928 at St. Mary’s Hospital in London discovered a substance from fungus Penicillium notatum
  • Named it penicillin
History of Antibiotics

• Gerhard Domagk
  • 1935 published report on Sulfas

• Selman Waksman
  • 1943 Discovered streptomycin which was effective against tuberculosis
History of Antibiotics

- Howard Florey and Ernst Chain
  - In 1940’s used mouse protection test to test penicillin on 8 mice
  - Started to purify and develop methods to mass produce penicillin
History of Antibiotics

• United States starts to gear up production in the 1940’s for military use in WWII

• 1942 First civilian patient in USA
  • 33 year old woman in Connecticut with *Strep* infection
  • Died in June 1999
FIGURE 2. The 10 leading causes of death as a percentage of all deaths — United States, 1900 and 1997

1900

- Pneumonia
- Tuberculosis
- Diarrhea and Enteritis
- Heart Disease
- Stroke
- Liver Disease
- Injuries
- Cancer
- Senility
- Diphtheria
History of Antibiotics

- Large drop in human deaths from infectious disease in last 100 years attributed to:
  - Improvements in sanitation and hygiene
  - Discovery of antibiotics
  - Childhood vaccination programs

CDC MMWR July 30, 1999/Vol. 48/No. 29
History of Antibiotics

- One of first uses in animals in USA was in New York State
  - *Strep ag* mastitis infection
  - Dewey herd in 1946
  - Founded QMPS service
How Antibiotics Work in Animals

- Antibiotics vs antimicrobials
  - **Antibiotics** are compounds produced by living organisms that impeded the growth of other organisms
  - **Antimicrobials** include antibiotics as well as synthetic compounds and semi-synthetic compounds that impeded the growth of other organisms. Include antivirals and antifungals
How Antibiotics Work in Animals

• **Bactericidal**
  • Tend to kill off bacteria
    • Penicillin, cephalosporins, and fluoroquinolones

• **Bacteriostatic**
  • Inhibit or arrest growth
    • Tetracyclines and macrolides
How Antibiotics Work in Animals

- Calf or cow’s immune system is still the most critical factor
  - Not all cattle respond the same
    - Why?
How Antibiotics Work in Animals

White Blood Cell destroying E. coli
How Antibiotics Work in Animals

• Modes of action
  • Inhibit cell wall synthesis
    • Penicillins and cephalosporins
  • Punch holes in the walls of the house or knock the windows and doors out
How Antibiotics Work in Animals

• Modes of action
  • Inhibit protein synthesis
    • Tetracyclines and macrolides
  • Knock out the interior walls and the ceiling

Downloaded from: http://www.3dscience.com/3D_Models/Biology/Bacterial/Ecoli.php
How Antibiotics Work in Animals

• Modes of action
  • Inhibit DNA function
    • Sulfas and fluoroquinolones
  • Mess with the electricity, plumbing, and heating setup
How Antibiotics Work in Animals

• Two large categories of bacteria based on differences in cell wall
  • Gram positive bacteria
    • Strep, Staph, Listeria
  • Gram negative bacteria
    • E.coli, Salmonella, Mannheimia, Pasteurella

How Antibiotics Work in Animals

• Broad spectrum versus narrow spectrum
  • Refers to what type of bacteria will be affected by the antibiotic
  • Do we know the most likely bacteria?
How Antibiotics Work in Animals

- What happens if antibiotics kill off good bacteria as well as the bad bacteria?
How Antibiotics Work in Animals

Also think about duration
Salmonella Dublin

- Host adapted strain for cattle
  - Carrier animals
- Since the early 1990’s multi-drug resistant
  - Sensitive to only 4/17 antibiotics
- Zoonotic
- Treatment versus prevention
Salmonella Dublin

• 1988-1995 *Salmonella* Dublin isolated from samples from farms in NY and PA
  • Calves, 7-16 weeks of age, presenting with pneumonia (2 adult cases)
• Not found between 1996 and 2006 at AHDC
• Has continued since September 2006
  • Multidrug resistant isolate
  • Epidemiologic link between many farms and a wider variation in disease presentation

McDonough et al., 1999
How Antibiotic Work in Animals

- Support the immune status of the cow or calf
  - Good nutrition
  - Vaccination
- Preventing or minimizing exposure by good management and good husbandry
Summary

• Antibiotics have not been around long
• Great tool to bridge the gap in immune function
• Choose wisely and with veterinary consultation
• Will not overcome poor health and management
• Focus on prevention of disease rather than treatment
Questions?