# Antibacterials in Wildlife Rehabilitation

Erica A. Miller, DVM

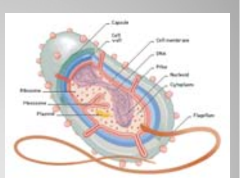
w/ thanks to
Pam Reger, & Drs. Pat Klein, John Huckabee, & Deb Anderson

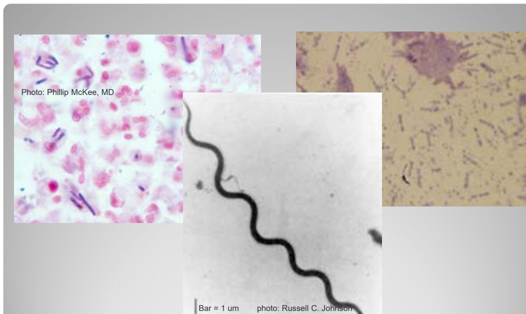
## What's an Antibiotic?

- **Antibiotic:** literally, against life
- **Antimicrobial:** an agent that causes destruction or inhibition of microorganisms
- **Antibacterial:** an agent that causes destruction or inhibition of bacteria

## What's a Bacteria?

- Prokaryote
  - no nucleus, mitochondria, or any membrane-bound organelles
  - Has DNA and RNA
- May live in or on another organism
- May cause an immune reaction in the "host" organism



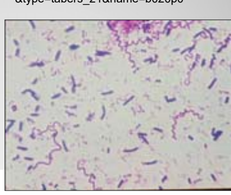



## Bacteria

## Bacteria Shapes

- Cocci (beads)
  - Staphylococcus
  - Streptococcus
- Rods
  - Salmonella
  - Escherichia
  - Bacillus
- Spirochetes
  - Leptospira
  - Borellia

http://www.tabers.com/tabersonline/ub?cmd=repview&type=tabers_21&name=b020p0



http://people.bethel.edu/~johgre/bio114d/Bacteria protozoa/Eubacteria/aBacteria%203typesGram.jpg

## Gram Staining

- Crystal Violet (purple)
- Iodine
- Decolorizing Alcohol
- Safranin (pink) counterstain


http://janiceatmeredith.files.wordpress.com/2012/01/gramsta.gif

## Gram Stain Results

- **Positive is Purple**
  - Complex cell wall picks up purple stain
  - All cocci are Gm+
  - Usually sensitive to Penicillins
- **Negative is Pink**
  - Lipopolysaccharide dissolves--purple stain washes out
  - Generally more virulent

## Acid-Fast Stain

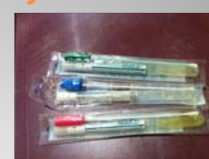
- Don't stain well with Gram stain
  - Concentrated Carbol-fuchsin
  - Decolorize
  - Methylene blue
- Mycobacteria
- Cryptosporidium


## Aerobic vs. Anaerobic

- Aerobic
  - Require oxygen
- Anaerobic
  - Die in oxygen
- Facultative Anaerobe
  - Survive anywhere

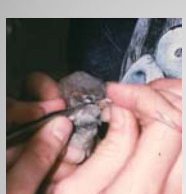

## Culture & Sensitivity

- Swab area in question – <u>without touching</u> <u>*anything*</u> but what you intend to culture
- Immediately place the swab in the culturette tube
- Allow to sit at room temp for about 20 minutes
- Place in fridge and arrange to send/drop off
- Results only as good as the sample!




## PCR Testing

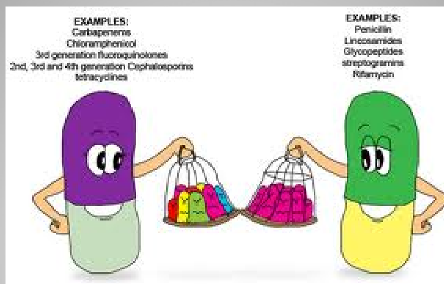
May require specific media; contact the lab you are using




## What's an Antibiotic?

- **Antibiotic:** literally, against life
- **Antimicrobial:** an agent that causes destruction or inhibition of microorganisms
- **Antibacterial:** an agent that causes destruction or inhibition of bacteria

## Broad Spectrum Narrow Spectrum




www.Iforgotwhichwebsitelstolethisonefrom.com

## Bacteriostatic

- Stop the bacteria from growing or replicating


## Bactericidal

- Actually kill the bacteria by various modes
- May be dose dependent
- Two bacteriostatic drugs combined

## But more is not always better…

- Higher dose may be toxic
- Don't combine bactericidal with bacteriostatic….may decrease efficacy
- Check the package inserts or the Formulary!

## Nor is less better…

- Bacterial reproductive cycle is very short→ many generations produced in a short amount of time
- Genetic mutations adapt them to their new, harsher environment
- These traits are passed on to subsequent generations
- Only a few need to survive to recolonize a host with newer, stronger genetic material


http://2.bp.blogspot.com/-juXAFb30PEE/Tdcm5rEiJNI/AAAAAAAAAWg/3CRzSKR7fKU/s1600/cartoon10.jpg

## Mnemonic to help Mnemember

**Bacteriostatic (SLCT)**

- **S**ulfonamides
- **L**incosamides
- **C**hloramphenicol
- **T**eteracyclines

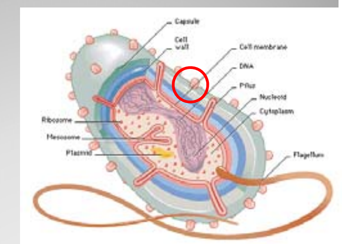
**Static/Cidal (dose dep)**

- **M**acrolides
- **L**incosamides

**Bactericidal (CAMPS-TF)**

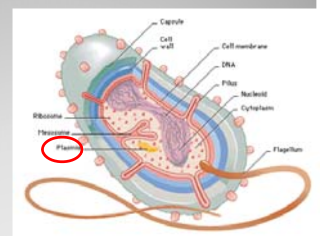
- **C**ephalosporins
- **A**minoglycosides
- **M**etronidazoles
- **P**enicillins
- **S**ulfonamides with **T**rimethoprim
- **F**louroquinolones

- Penicillins
- Cephalosporins
- Vancomycin



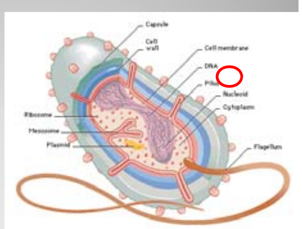
## Inhibit Cell Wall Synthesis

- Aminoglycosides
- Erythromycins
- Lincomycin
- Tetracyclines
- Chloramphenicol



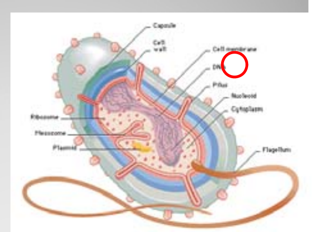
## Inhibit Protein Synthesis

- Sulfonamides
- Trimethoprim



## Inhibit Nucleic Acid Synthesis

- Quinolones
- Metronidazole



## Alter Structure/Function of DNA

## REALITY

- Limited time
- Limited funding

- How do we choose?

ANTIBIOTIC 1 BACTERIA 0

| Bactericidal Party | Bacteriostatic Party |
| --- | --- |
| Ms. Clara M. Phenicol | Ms. Penny Cillin |
| Mr. Tetra Cycline | Ms. Polly Mycin |
| Mr. E. Rythromycin | Mr. Gent A. Micin |


## Goal #1: Choose the right drug

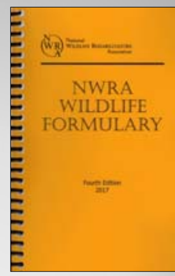
- Based on likely cause (e.g., rabbit abscesses are usually Gram +)
- Based on research (e.g., Clavamox most effective for cat bites)
- Based on Gram Stain (e.g., organism is G-, so use something that gets G-)
- Check Indications in the NWRA Wildlife Formulary

## Goal #2: Ensure drug can reach infection



ADME: Indications in Formulary

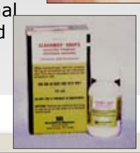
## Goal #3: Provide the right dose


## Goal #4: Supportive Therapy


## Penicillins - Bactericidal

- Inhibits cell wall synthesis
- Broad spectrum: 1°-ly Gram+, anaerobes
- Excreted: kidneys
- Wide distribution
- Generally very safe
  - Oral may kill normal flora of rabbits and rodents



- Semi-synthetics: Carbenicillin and Piperacillin
  - more Gram-
- Good choice for mixed infections that are predominately Gram+


## Penicillins

- Inhibits cell wall synthesis
- Broad spectrum & anaerobes
- Higher generations: More Gram –
- Well distributed
- Excreted via kidney
- Generally very safe
  - Careful in rabbits & rodents


## Cephalosporins - Bactericidal

## Cephalosporins

- 1st Generation
  - Gm+ and anaerobes; few Gm-
  - Cefazolin, Cephalexin, Cephalothin, Cefadroxil
- 2nd Generation
  - Gm+ and Gm-
  - Cefoxitin, Cefuroxime
- 3rd Generation
  - Gm+, Gm- including *Pseudomonas, Proteus, Enterobacter, Citrobacter*
  - Ceftiofur, Cefotaxime


## Tetracyclines - Bacteriostatic

- Broad spectrum
  - Gram + and –
  - *Mycoplasma, Chlamydophila* (doxycycline)
- Action: 30S ribosome
- Distribution: GI, respiratory, intestine, skin, intracellular
- Side effects:
  - Hypersensitivity, photophobic
  - Bone & teeth changes
  - Calcium in GI tract of rabbits & rodents may inactivate


## Aminoglycosides - Bactericidal

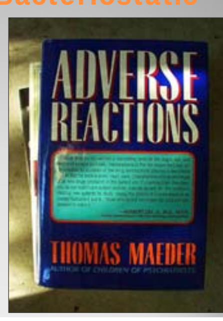
- Broad spectrum: Gram -
- Inhibit protein synthesis (30S)
- Excreted unchanged via kidneys
- Distribution: Bone, ears, kidneys, heart, gallbladder
- Toxicities: nephrotoxic, ototoxic
- Recommend fluids during treatment
- Used in combination with penicillins or cephalosporins


## Choramphenicol - Bacteriostatic

- Broad Spectrum
  - Gm+, Gm-, *Rickettsia, Coxiella, Chlamydiophila*
  - Pseudomonas is resistant
- Inhibits protein synthesis
- Good distribution
- Metabolized in liver and excreted in urine


## Chloramphenicol - Bacteriostatic

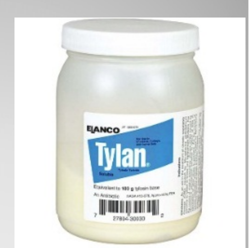
- **Side Effects:**
  - Bone marrow suppression; vomiting and diarrhea; delayed wound healing
  - May prolong action of other drugs
  - Cross resistance with tetracyclines, erythromycin, ampicillin
  - Wear gloves!!




## Macrolides – Bacteriostatic / cidal

- Gm+ and anaerobes; a few Gm-: *Neisseria, Hemophilus, Mycoplasma*
- Inhibits protein synthesis
- Distribution:
  - Milk and other secretions, lungs, wounds, osteomyelitis,
  - Doesn’t reach CSF very well
- Metabolized in liver and excreted in urine

- Erythromycin, Tylosin



- Inactive in acid environments (abscesses)
  - Coated tabs protect from stomach acid (don't split!) don't give with food (slows absorption)
- Side effects:
  - Mild GIT signs – DON'T USE in horses, ruminants, rabbits, hamsters, guinea pigs!


## Macrolides – Bacteriostatic / cidal

- All Gm+ cocci and bacilli, mycoplasma (not Gm-)
- Inhibit protein synthesis
- Distribution
  - Bone, peritoneal fluid, pericardial fluid, placenta; low concentration in CSF
- Excreted in urine, bile, milk
- Side effects:
  - Minimal, but don't use in ruminants or rabbits!
  - May see neuromuscular effects with anesthesia
- Lincomycin and Clindamycin (Antirobe)


## Lincosamides – Static / Cidal

## Metronidazole - Bactericidal

- Anaerobes: *Clostridium*, *Bacteroides*, *Fusobacterium*
- Flagellates (*Giardia*, *Trichomonas*) & Amoeba (*Entamoeba*, *Balantidium*)
- Disrupts DNA synthesis
- Metabolized in liver, excreted by kidneys
- Distribution
  - crosses blood-brain barrier
- Use prohibited in food ans.
- Side effects
  - Hepatotoxic
    - Hepatic encephalopathy
    - Deaths reported in CA and AZ Mtn King Snakes, Indigo snakes
- Appetite stimulant?

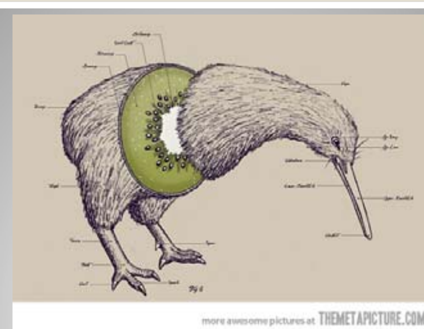

## Trimethoprim-Sulfadiazine - Bactericidal

Broad spectrum

- Folic acid synthesis
- Distribution: GI, respiratory, skin
- Metabolized by liver, excreted by kidneys
- Side effects:
  - Dry eye, crystalluria
- Other effects
  - Coccidiostatic
  - *Cryptosporidium*-???


- Broad spectrum, but not anaerobes
- Alters DNA gyrase
- Rapid absorption and good distribution
- Metabolized by liver, excreted by kidneys
- Side effects:
  - cartilage erosions, painful injection
- Use prohibited in food animals


## Quinolones - Bactericidal




## Questions?

## Thank you!

## Bacteria cause:

- Abscesses
- Local infections
  - Pneumonias
  - Bone infections (osteomyelitis)
  - CNS infections (not common)
- Systemic infections (bacteremia = bacteria in blood)

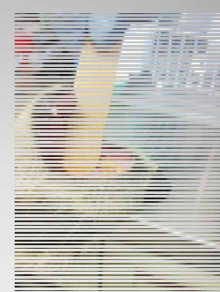
## Staph. infections

One or many localized, walled-off areas of infection


Aspirate, lance, flush, antibiotics

## Abscess

- Young raccoon
- Stopped eating
- Exam→ yellow caseous debris in roof of mouth



## Bacterial Abscesses (skin)

- Localized, walled off areas of infection
- Often mixed infection
- May rupture spontaneously
- Aspirate, lance, flush, local & systemic antibiotics

## Bacterial Sinusitis

- Caseous material +/or mucoid fluid in

- Distortion of face or upper palate

## Bacterial Sinusitis

- Smears, bacterial cultures
- Appropriate systemic antibiotics; anti-biotic ophthalmic drops applied to nares BID

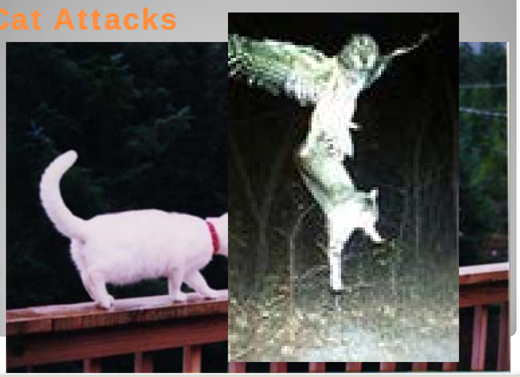
Photo: Sallie Welte, VMD

## Cat (& Dog) Attacks

- Most often fledglings
  - Punctures
  - Fractures
  - Feather loss
  - Internal hemorrhage
  - Infections
- Usually fatal if not treated

http://www.abcbirds.org/cats/

## Cat Attacks

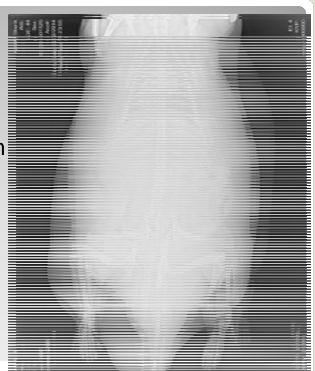


## Cat attacks

- *Pasteurella multocida*
- *+ 63 other bacteria*

## Osteomyelitis

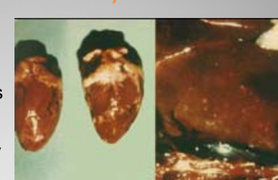
- Occurs with open fractures, joint infections, or when the periosteum is penetrated



## Avian Cholera (Pasteurella)

*Pasteurella multocida*

- Most frequent in waterfowl, gulls & crows
- Acute death or lethargy, convulsions, erratic flight, mucous or bloody discharges
- Can die 6-12 hours after exposure
- Transmission via contact, ingestion or aerosol



Rose Lake Wildlife Disease Laboratory

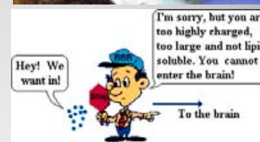
- Winter/Spring die-offs
- Crowding/Stress
- Collect tissues aseptically & submit

## Bacterial Pneumonia

- Often from food aspiration
- Require inciting 'nidus' to enter lung
- Need an antibiotic that enters lung well
- Provide supplemental $O_2$

## CNS infection

- Not commonly diagnosed in wildlife, but can occur
- Usually bite wound to head or spine
- Streptococcus, Listeria, Haemophilus and Neisseria may spread to CNS
- Not many abx penetrate BB barrier




https://faculty.washington.edu/chudler/gif/bbbcart.gif

## Salmonellosis

*Salmonella spp.*

- *G- rod*
- Normal flora
- Fecal transmission
- Some strains more pathogenic than others
- Depression, dehydration, localized infections

## Salmonellosis at Feeders

Photo: David Smith, Grand Junction, CO

- Often pine siskins and finches
  - *S. typhimurium*
  - Fluffed, lethargic, swollen eyelids
  - Inflammation & necrosis of crop

## Salmonellosis

*Salmonella spp.*

- Normal flora; Gram negative
- Fecal transmission
- Diarrhea / enteritis dehydration, depression, death

Photo courtesy of Stuart Porter, VMD

## Mycoplasmal conjunctivitis

*Mycoplasma gallisepticum*

- G- amorphous
- House finches; goldfinches, blue jays, starlings
- Direct contact

Photo: Sallie Welte, VMD

## Mycoplasmal conjuntivitis

- Conjunctivitis, periocular inflammation, respiratory difficulty (dyspnea), sinusitis

Photo: Sallie Welte, VMD

## Mycoplasmal conjuntivitis

- Topical ophthalmic drops BID until eyes clear; AND
- Tylosin tartrate in water, 1mg/ml (1/4 tsp per qt) for 21 days

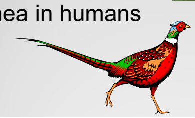

## Tularemia

*Francisella tularensis*

- *G- rod*
- Rabbits & Rodents
- Inhalation, contact with blood, ticks, deerflies
- Abnormal behavior:
  - Slow; tame; rub noses on ground; muscle spasms

## Campylobacteriosis

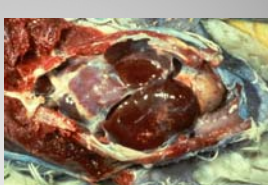
- G- rod, curved
- Wild ruminants, rodents and wildfowl
- Fecal/oral transmission
- Diarrhea in humans



## Ornithosis

*Chlamydophila psittaci*

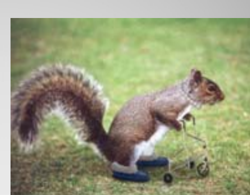
- Intracellular
- Psittacosis
- Pet birds, pigeons
- Fecal transmission
- Weight loss; lethargy
- Large liver and spleen on necropsy



Laurel Degerness, DVM

## Bordetella

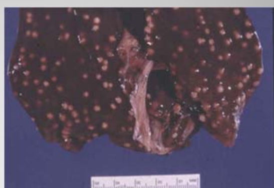
- Squirrels
- *B. bronchiseptica*
- Gram-
- Respiratory & lethargy
- Contagious
- TMS, Baytril, Doxy



## Tuberculosis

- *G+ sporeforming; acid-fast bacilli*
- *Mycobacterium avium*
- Fecal transmission
- Liver, spleen, intestines

- *M. bovis*
- Swollen lymph nodes and nodules in chest & lungs in deer
- Usually chronic, low-grade disease



James Runningen

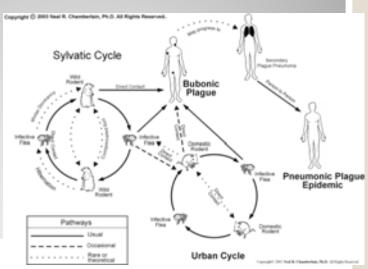
## Leprosy

- *Mycobacterium leprae*
- G+ Acid fast bacilli
- Armadillo
- Small swellings to ulcerative sores
- Skin scraping w/ AF stain or lesion in formalin

http://animaltourism.com/news/2011/04/28/armadillo

## Plague

- Yersinia pestis
- G- coccoid rod
- Trans. by fleas
- Sylvatic cycle in wildlife
- Lymph nodes or lungs

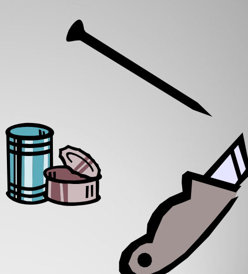



## Plague

- Land of the Flea and Home of the Plague…


## Tetanus

*Clostridium tetani*
- G+ spore-forming rod
- Rarely diagnosed, but can occur
- *More of a threat to people!*
- Bacteria enters cuts
- Paralysis



## Pseudomembranous Colitis

*Clostridium difficile*
- weaning: stress, diet change, gi flora change
- bloating, diarrhea, sudden death
- Gram stain/culture
- antibiotics, probiotics, lower stress

## Tyzzer's Disease

- *Clostridium piliformis*
- Most common in muskrats
- Diarrhea, tarry feces, depression, anorexia, death
- Often stress related
- PM diagnosis of tissues in formalin

http://images.fws.gov/

## Dermatophilosis

*Dermatophilus congolensis*

- *G+ bacilli*
- Hair loss & crusy scabs
- Espec. on face
- Scraping of lesions
  - Stain to see bacteria
  - Or submit in formalin

Field Manual of Wildlife Diseases in the Southeastern US

## Case #1

- Adult woodchuck
- Emaciated, 8%dehyd
- Nasal discharge and inspiratory wheeze
- Was on amoxicillin for 6 days, improved but is now worse

## Woodchuck

- Respiratory
- Chronic
- Chronic
- Bactericidal antibiotic for Gm-, that reaches respiratory tract

- usually Gram -
- use bactericidal
- immune system compromised
- Cephalosporin or Aminoglycoside

## Case #2

- Songbird attacked by cat
- Wounds are minor

## Cat attack songbird

- Cat mouth
- Songbird
- Broad-spectrum, esp. Gram-; low concentration; oral liquid

- many bacteria including Pasteurella
- Small dose, probably orally
- Clavamox liquid or Baytril injectable given orally

- Raccoon with abscess on foreleg
- Appears walled-off or at least only on that part of leg

## Case #3

- Walled-off abscess
- Swab content during debridement
- Open wound

- Need to lance it
- Make slide; save some for C & S
- Flush well and topical AND systemic antibiotic

## Raccoon

- Peregrine falcon, shot
- Fractured ulna
- Wound is clean
- Falcon is shocky
- 6-8% dehydrated

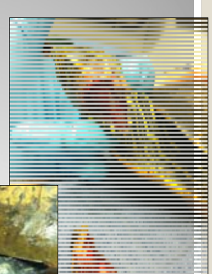
## Case #4

- Going into shock
- Bone fracture with likely infection
  - Gm+ or anaerobe
- Penetrating wound & fractured ulna

- Stabilize: quiet & heat, fluids +/- RR, midazolam
- Cephalosporin (1st gen) or Lincosamide (Clindamycin)
- Clean well, leave open, Fig 8 wrap

## Peregrine

- Aquatic turtles
- Diesel spill during hibernation
- Surfaced 4 wks later
- Skin slough



## Case #5

- Aquatic (i.e., need to be in water)
- Assume wound contaminated
- Possibly still had diesel in skin

- Soaked in dilute Betadine & applied topical SSD & dry dock 20-30 min BID
- Ceftazidime Q72 hr
- Eventually applied Collasate SID

## Turtles