Number 7

# PHOENIX FLYER

November 2005

## Guide to Minimum Inhibitory Concentration (MIC) Part II

In Part I of our MIC article (from September's Flyer) we discussed what MIC is and how it can be used to better treat our patients. In Part II we focus on causes for treatment failures and provide information on the first set of individual antibiotic classes. In our next Newsletter, we will hopefully have room for the rest of the antibiotic classes, so stay tuned!

### Factors That Cause Treatment Failure

1. **Development of bacterial resistance** – Normal body flora, particularly in the GI tract, is very diverse. To maintain the balance of the flora, some of these bacteria produce their own antibiotics to suppress the growth of other bacteria. The bacteria that produce the antibiotic, as well as the normal surrounding bacteria are resistant to the antibiotic. The administration of antibiotics also exposes the resident bacteria, and those that survive develop resistance to the antibiotic. Both of these types of resistance are passed along in the genetic structure of the bacteria.
2. **Multidrug resistance (MDR)** - Now considered the normal response to antibiotics for gram positive cocci i.e. pneumococci, enterococci and staphylococci. Among these, *Staphylococcus aureus* is considered most problematic, because it is intrinsically virulent, is able to adapt to many different environments and because it tends to be associated with life threatening infections. The term "Methicillin Resistant Staphylococcus aureus" (MRSA) is virtually synonymous with MDR *Staphylococcus aureus*. MRSA refers to those strains of *Staphylococcus aureus* organisms that are resistant to semi-synthetic beta-lactams, including methicillin. *E.coli* is another organism which appears to develop resistance rapidly when exposed to selected antibiotics and multiple mechanisms of resistance often lead to MDR.
3. **Bacterial production of a biofilm** – Biofilms are microcolonies of pathogenic and host microbes embedded in a polysaccharide matrix. Staphylococcal pyoderma is caused by organisms that produce a "slime" material that facilitates bacterial adhesion to cells. Nocardia forms calcium-containing "sulfur granules" that greatly reduce the amount of drug reaching the bacteria. Many gram negative organisms produce a biofilm to protect them from adverse environmental conditions, such as the presence of antibiotics. This has been documented in *E. coli* urinary tract infections in people and mice.
4. **Insufficient dosing of drug** – The peak concentration and rate of elimination of a drug help determine whether sufficient amounts of drug reach the target organ. The dosing interval as well as the mode of action of the antibiotic need to be considered when choosing the appropriate therapy. A drug that is bactericidal may not need to achieve and maintain peak plasma concentrations for as long as a bacteriostatic drug. Slow growing organisms or tissues with poor drug penetration, may need to be treated for prolonged periods of time.
5. **Substances released from bacteria that damage host tissues or alter the host's response to the bacteria** – Some gram positive organisms, particularly the Staphylococci, produce substances that directly damage host tissues and impair the body's immune response.

*(Continued on page 2)*

## New Reference Ranges!

Did you overlook the new reference ranges sent out in a recent technical bulletin?

Our Pathologists review your blood smears daily and accept an unlimited amount at no additional charge!

***A friendly reminder to all practioners regarding Equine Infectious Anemia; EIA testing is federally regulated. Please be sure that the paperwork is completely filled out. The Doctor's signature is especially important. It is also essential to write an identifier on the tube, which correlates to what has been written on the submitted form. A horse's registered name, barn name or number is acceptable.***

## EDUCATION CORNER

### Wetlab Space Available For Urinalysis

**Dates are confirmed for upcoming wetlab!**

**January 14 & January 15, 2006**
with Dr. Sturtevant

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ANAV Meeting at 7:30PM, Phoenix Laboratory
On November 15th!
Subject of discussion: Ferret Polymyositis

**In This Issue...**



## For Your Information

### Lab Jargon Definitions

**"Morphology":** Morphology represents a description of RBC's & platelets. In your CBC report, the morphology section will quantitate any morphology changes. If no quantity is noted, then the morphology is normal.

## Avian Annotation

Normal T4 values for birds vary widely by species and values are frequently lower than mammalian values. Hypothyroidism should not be diagnosed based on one low result due to diurnal variation of T4 levels and because of assay limitations at very low concentrations, which are typical of birds. Some references recommend TSH stimulation testing, however, TSH is not currently available.

## ....MIC (Part II)

*(Continued from page 1)*

### Selection of Antibiotics

There are three general uses for antibiotics: (1) Empirical – the antibiotic(s) must "cover" all likely pathogens, (2) Definitive – narrow spectrum, low-toxicity, and (3) Prophylactic – broad or narrow spectrum to prevent infection. While it is optimal to obtain culture and sensitivity data for every infection you treat, it is not practical. The empirical and prophylactic use of antibiotics is the norm in veterinary practice. The following information on antibiotic classes should be used to help you make rational choices when treating empirically or prophylactically.

### Sulfonamides/Trimethoprim sulfamethoxazole

Uses: Urinary tract infections, otitis, bronchitis, sinusitis

Susceptible organisms: Most coliform rods, staphylococci, *Nocardia, Actinomyces,* and *Chlamydia*

Pharmacokinetics: Rapidly absorbed in the GI tract (except Sulfadiazine). Readily enters pleural, peritoneal, synovial, ocular and other body fluids (50-80% of plasma concentrations). Drugs are bound to albumin. Active form is unbound, therefore, tissue fluids low in protein content have more readily available active drug.

### Antiseptic Agents

**▪Methenamine (Not an antibiotic)**

Uses: Urinary tract infections – particularly as chronic suppressive therapy for *E. coli* UTI

Susceptible organisms: *E.coli* and other gram negative organisms that do *not* split urea (*Proteus spp.* are resistant because the urine needs to be acidic and this organism is a urea splitter that raises the pH).

Pharmacokinetics: Decomposes in water to form formaldehyde. Bacteria do not develop resistance to formaldehyde.

**▪Nitrofurantoin**

Uses: Urinary tract infections

Susceptible organisms: *E.coli,* and many enterococci. Many strains of *Enterobacter, Proteus, Pseudomonas and Klebsiella* are resistant.

Pharmacokinetics: Rapidly excreted, with very low plasma levels, but concentrates in urine. Bacteriostatic drug that requires breakdown into its active form by metabolites from bacteria, therefore there needs to be high concentrations of the bacteria. Resistance is rare.

### Fluoroquinolones

Uses: Urinary tract infections including pyelonephritis and prostatitis, pneumonia, hepatobiliary infections

Susceptible organisms: Intracellular bacteria (such as *Chlamydia, Mycoplasma, Legionella, Brucella, Mycobacterium),* most coliform rods (such as *E.coli, Salmonella, Klebsiella, Enterobacter)* and *Campylobacter.*

Pharmacokinetics: Most Fluoroquinolones are rapidly absorbed from the GI tract – 80% or greater absorption of Enrofloxacin, but Ciprofloxacin has 40% or less absorption. Approximately 10 - 40% of Enrofloxacin is converted to Ciprofloxacin in the body. Fluoroquinolones reach highest concentration in urine, kidney, lung, prostate, stool, bile, and macrophages and neutrophils. There are many documented cases of Baytril causing blindness in cats at higher once a day dosages and anecdotal reports of blindness at the lower divided BID doses.

To Be Continued...

## New Drug/Disease Panels

Look for our new panels created to monitor drugs and diseases...

New Tests

ACE Inhibitors, Addison's Disease, Diabetes Mellitus, Tapazole, Soloxine, Phenobarbital, Cushing's Disease, Diazepam, Diuretics, Aminoglycosides, Prednisone, KBr, Digoxin, Kidney Disease, Tricyclic Antidepressants, Prozac, NSAID's, Calcitriol, Methylxanthines, Amlodipine, and Cyclosporin.