

# Antimicrobial Treatment of Urinary Tract Disease

TLC Forum 2015

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# Focus Points - Objectives

- Criterion for characterizing simple, uncomplicated versus complicated urinary tract infections
- Diagnosis, treatment and monitoring of urinary tract infections
- Subclinical bacteriuria, urinary catheter and upper urinary tract infections (pyelonephritis)
- Highlights of the recent ACVIM consensus regarding multi-drug resistant infections

## Why? ... new consensus and guidelines

**Antimicrobial use guidelines for treatment of urinary tract disease in dogs and cats: antimicrobial guidelines working group of the international society for companion animal infectious diseases.**

Weese JS, Blondeau JM, Boothe D, et al.

Vet Med Int [serial online] 2011;2011:263768.

Available at: [dx.doi.org/10.4061/2011/263768](http://dx.doi.org/10.4061/2011/263768).

# Why? ... AVMA & ACVIM endorsed

## **RESOLUTION 5-2015; AVMA Regular Winter Session**

**The AVMA endorses the 2011 Antimicrobial Use Guidelines for Treatment of Urinary Tract Disease in Dogs and Cats** developed by the Antimicrobial Guidelines Working Group of the International Society for Companion Animal Infectious Diseases.

- The AVMA recommends use of these guidelines as a resource for companion animal practitioners to improve antimicrobial stewardship.
- These are international guidelines, and veterinarians should use them in compliance with all applicable veterinary licensing and practice requirements.

# Why? ... regulation of antimicrobials is coming

## California bans OTC antibiotics in food animals

Also requires periodic training for veterinarians on 'judicious use' policy

October 12, 2015 (published)

By: [Christy Corp-Minamiji, DVM](#) 

For The VIN News Service

Bottles of penicillin and tetracycline on feed store shelves soon will be a thing of the past in California under legislation signed Saturday by Gov. Jerry Brown. Two new laws place responsibility for controlling antibiotic use in livestock on the shoulders of veterinarians in the state.

The California law goes further than [national efforts at restricting antibiotics in food animals](#) by not only prohibiting the use of antibiotics to promote livestock growth but also by removing medically important antibiotics from all over-the-counter (OTC) use. (The state defers to the U.S. Food and Drug Administration to define "medically important antimicrobial drug," pointing to the drugs listed in [FDA Guidance for Industry No. 152 Appendix A](#).)

Under the state legislation titled [Livestock: use of antimicrobial drugs](#), beginning Jan. 1, 2018, antibiotics may not be given to livestock in California without a veterinary prescription or veterinary feed directive (VFD).

# Why? ... UTI's are curable

**MOTHER GOOSE & GRIMM**

**MIKE PETERS**



# Simple, UNcomplicated Urinary Tract Infection

# Uncomplicated UTI - Criterion



- Less than 3 episodes per year
- Normal urinary tract anatomy and function
- Otherwise healthy individual / absence of comorbidities (e.g., diabetes mellitus, Cushing's, uroliths)
- Dysuria, pollakiuria with bacteriuria

# Uncomplicated UTI - Diagnosis

- Minimum database:
  - Urinalysis: specific gravity
  - Urinalysis: glucose level and sediment
  - Urine culture: “gold standard”
  - Urine culture: aerobic and quantitative



# Uncomplicated UTI - Diagnosis

- Urine culture – always culture
  - Cystocentesis preferred over catheterized sample
  - Free catch sample should not be used for culture
  - Refrigerate samples immediately
  - Samples that take 24 hours or more to reach the laboratory should be interpreted with caution because of the potential for both false positive and false negative results
  - Retesting is recommended if the refrigerated sample is more than 24 hours old

# Uncomplicated UTI – Diagnosis

## Colony counts (CFU/ml)

- Cystocentesis –
  - Any growth is significant, most UTI  $\geq 10^3$  colony forming units (CFU)/ml
  - Small numbers of pathogenic skin commensals are likely contamination (i.e. coagulase - negative staphylococci)
- Urinary catheter –
  - $\geq 10^4$  CFU/ml in males and  $\geq 10^5$  CFU/ml in females are usually significant
  - Sample from male dogs are usually adequate
  - Consider confirming with cystocentesis in a female
- Free catch samples - not considered diagnostic

# Uncomplicated UTI – Treatment

## First-line drugs – start pending culture

- Amoxicillin x 7-14d
- Trimethoprim-sulfonamide x 3-14 days
- Amoxicillin/clavulanic acid is acceptable
  - lack of evidence regarding the need for clavulanic acid
  - use narrowest spectrum drug
- Reserve fluoroquinolones and extended-release cephalexin (i.e. cefovecin) for complicated or resistant infections



# Uncomplicated UTI – Treatment

## Short duration protocol advantages

- Decrease bacterial load
- Control clinical signs
- Immune system eliminates remaining organisms
- Better compliance, lower cost, decreased adverse effects

# Uncomplicated UTI – Treatment 3 day TMP-SMX protocol

J Vet Intern Med 2014;28:818–826

## **Short- and Long-Term Cure Rates of Short-Duration Trimethoprim-Sulfamethoxazole Treatment in Female Dogs with Uncomplicated Bacterial Cystitis**

S. Clare, et. Al.

**Methods:** Randomized, double-blinded, placebo-controlled clinical trial. Dogs were treated with **TMP-SMX (15 mg/kg PO q12h for 3 days; n = 20)** or **cephalexin (20 mg/kg PO q12h for 10 days; n = 18)**.

**Results:** No statistically significant differences were found between treatment groups in clinical cure rates after 3 days of treatment or >30 days after conclusion of treatment or in microbiological cure rates 4 days after conclusion of treatment.

**Conclusions and Clinical Importance:** We did not identify a difference in cure rates between short-duration sulfonamide and long-duration beta-lactam treatments in female dogs with uncomplicated cystitis. Long-term cure rates in both treatment groups were low.

# Uncomplicated UTI – Treatment - Flouroquinolone update

- Routine use for UTI is discouraged → G+ inherently resistant and developing resistance of G- (especially E. coli)
- Variable cross-resistance
- Cross-resistance not reported with pradofloxacin (third-generation), yet...



## **Comparison of Pharmacodynamic and Pharmacokinetic Indices of Efficacy for 5 Fluoroquinolones toward Pathogens of Dogs and Cats**

Dawn Merton Boothe, et. Al.

**Methods:** compared prospectively at low and high doses (mg/kg) for ciprofloxacin (5 and 20), difloxacin (5 and 10), enrofloxacin (including enrofloxacin+ciprofloxacin) (5 and 20), marbofloxacin (2.5 and 5), and orbifloxacin (2.5 and 7.5).

**Results:** Percent resistance did not differ among drugs or organisms.

The proportion of isolates for which a target was reached was: ciprofloxacin, enrofloxacin+ciprofloxacin, and marbofloxacin (77%), enrofloxacin (73%), orbifloxacin (51%), and difloxacin (40%); and at the low dose, enrofloxacin+ciprofloxacin and enrofloxacin (43%), ciprofloxacin (40%), marbofloxacin (39%), orbifloxacin (29%), and difloxacin (28%).

**Conclusions:** *E. coli* resistance to fluoroquinolones approximated 40%. For susceptible isolates, enrofloxacin, marbofloxacin, and ciprofloxacin more consistently reached indices associated with predicted efficacy, but **only at the high dose**.

# Uncomplicated UTI – Treatment

## 3 day enrofloxacin therapy

J Vet Intern Med 2012;26:506–512

### **Enrofloxacin Treatment Regimen for Uncomplicated Urinary Tract Infections in Dogs**

J.L. Westropp, et. Al.

**Methods:** Prospective, multicenter, controlled, randomized blinded clinical trial. Enrolled dogs were randomized to group 1 (**enrofloxacin 18–20 mg/kg PO q24h for 3 days**) or group 2 (**amoxicillin-clavulanic acid 13.75–25 mg/kg PO q12h for 14 days**).

**Results:** The microbiologic cure rate was 77.1 and 81.2% for groups 1 and 2, respectively. The clinical cure rate was 88.6 and 87.9% for groups 1 and 2, respectively. **Cure rates between groups did not differ** according to the selected margin of noninferiority.

**Conclusions and Clinical Importance:** HDSD enrofloxacin treatment was not inferior to a conventional amoxicillin/clavulanic acid protocol for the treatment of uncomplicated bacterial UTI in dogs.

# Uncomplicated UTI – Treatment Patient Monitoring & Follow-up

- None – if patient is asymptomatic and no resistance
- If culture returns resistant bacteria
  - Good clinical response => maintain the current treatment
  - Poor clinical response => change drugs
  - Follow-up urinalysis and culture 7 days after treatment is completed

**COMPLICATED**

**Urinary Tract Infection**

# COMPLICATED UTI - Criterion



- 3 or more culture positive UTIs over 12 months
- OR the presence of an anatomical or functional abnormality or comorbidity such as prostatitis, urinary calculi, neurogenic bladder, diabetes or immunocompromising disorders

# COMPLICATED UTI – Categories Reinfection, Relapse or Refractory

- Reinfection
  - Different microorganism isolated
  - Same microorganism but different bacterial antimicrobial susceptibility patterns *may be* helpful



# COMPLICATED UTI – Categories Reinfection, Relapse or Refractory

- Relapse
  - Indistinguishable microorganism identified
  - Relapses tend to occur earlier than reinfection's, usually within weeks rather than months
  - Usually there is a period of apparent bladder sterility during treatment



# COMPLICATED UTI – Categories Reinfection, Relapse or Refractory

- Refractory
  - Persistently positive results based upon culture during treatment
  - Treatment based on in vitro susceptibility
  - No period of elimination of bacteria during or after treatment



# COMPLICATED UTI - Diagnostic checklist

- Confirm client compliance
- Complete physical examination with rectal palpation and examination of the reproductive tract
- CBC
- Serum chemistry biochemical profile
- Complete urinalysis
- Urine culture via cystocentesis
- Imaging (radiographs/abdominal ultrasound)
- Endocrine testing if indicated
- Advanced diagnostics such as cystoscopy, cystourethrogram or MRI may be indicated
- If cystotomy is performed, culture the bladder wall and uroliths

# COMPLICATED UTI - Therapy

- Wait for culture results if able, otherwise treat as uncomplicated
- Avoid antibiotics whose active form are not predominantly secreted in the urine (macrolides – Azithromycin, Erythromycin)
- Consider referral or consultation
- May need to use drugs of intermediate sensitivity (target site or dosage increase)
- Change drugs if resistance identified via urine culture
- Assess the relevance of each bacteria cultured
- *Enterococcus spp* will often resolve when the other organism is treated
- Treat both if able, otherwise target the one that's most clinically relevant keeping in mind any underlying disease or pyelonephritis

# COMPLICATED UTI - Therapy

- No evidence to support using clarithromycin to break down the bacterial biofilm
- No evidence to support instilling antimicrobials, antiseptics or DMSO into the bladder (flushed out quickly and can be locally irritating)
- Manage the underlying disease processes
- **Emphysematous cystitis** - often associated with glucose fermenting bacteria (E coli, Proteus spp, Clostridium spp, Aerobacter) and diabetes
- **Polypoid cystitis** may require long-term antimicrobials to eliminate deep-seated bacterial infection

# COMPLICATED UTI – Therapy

see Web-published Handout

TABLE 2: Antimicrobial treatment options for urinary tract infections in the dog and cat.

Drug	Dose	Comments
Amoxicillin	11–15 mg/kg PO q8h	Good first-line option for UTIs. Excreted in urine predominantly in active form if normal renal function is present. Ineffective against beta-lactamase-producing bacteria.
Amikacin	Dogs: 15–30 mg/kg IV/IM/SC q24h Cats: 10–14 mg/kg IV/IM/SC q24h	Not recommended for routine use but may be useful for treatment of multidrug resistant organisms. Potentially nephrotoxic. Avoid in animals with renal insufficiency.
Amoxicillin/clavulanate	12.5–25 mg/kg PO q8h (dose based on combination of amoxicillin + clavulanate)	Not established whether there is any advantage over amoxicillin alone.
Ampicillin		Not recommended because of poor oral bioavailability. Amoxicillin is preferred.
Cephalexin, Cefadroxil	12–25 mg/kg PO q12h	Enterococci are resistant. Resistance may be common in Enterobacteriaceae in some regions.
Cefovecin	8 mg/kg single SC injection. Can be repeated once after 7–14 days.	Should only be used in situations where oral treatment is problematic. Enterococci are resistant. Pharmacokinetic data are available to support the use in dogs and cats, with a duration of 14 days (dogs) and 21 days (cats). The long duration of excretion in the urine makes it difficult to interpret posttreatment culture results.
Cefpodoxime proxetil	5 to 10 mg/kg q24h PO	Enterococci are resistant.
Ceftiofur	2 mg/kg q12–24h SC	Approved for treatment of UTIs in dogs in some regions. Enterococci are resistant.
Chloramphenicol	Dogs: 40–50 mg/kg PO q8h Cats: 12.5–20 mg/kg PO q12h	Reserved for multidrug resistant infections with few other options. Myelosuppression can occur, particularly with long-term therapy. Avoid contact by humans because of rare idiosyncratic aplastic anemia.
Ciprofloxacin	30 mg/kg PO q24h	Sometimes used because of lower cost than enrofloxacin. Lower and more variable oral bioavailability than enrofloxacin, marbofloxacin, and orbifloxacin. Difficult to justify over approved fluoroquinolones. Dosing recommendations are empirical.
Doxycycline	3–5 mg/kg PO q12h	Highly metabolized and excreted through intestinal tract, so urine levels may be low. Not recommended for routine uses.
Enrofloxacin	5 mg/kg PO q24h (cats) 10–20 mg/kg q24h (dogs)	Excreted in urine predominantly in active form. Reserve for documented resistant UTIs but good First-line choice for pyelonephritis (20 mg/kg PO q24h). Limited efficacy against enterococci. Associated with risk of retinopathy in cats. Do not exceed 5 mg/kg/d of enrofloxacin in cats.
Imipenem-cilastatin	5 mg/kg IV/IM q6–8h	Reserve for treatment of multidrug-resistant infections, particularly those caused by <i>Enterobacteriaceae</i> or <i>Pseudomonas aeruginosa</i> . Recommend consultation with a urinary or infectious disease veterinary specialist or veterinary pharmacologist prior to use.
Marbofloxacin	2.7–5.5 mg/kg PO q24h	Excreted in urine predominantly in active form. Reserve for documented resistant UTIs but good First-line choice for pyelonephritis. Limited efficacy against enterococci.
Meropenem	8.5 mg/kg SC/IV q 12 (SC) or 8 (IV)h	Reserve for treatment of multidrug-resistant infections, particularly those caused by <i>Enterobacteriaceae</i> or <i>Pseudomonas aeruginosa</i> . Recommend consultation with a urinary or infectious disease veterinary specialist or veterinary pharmacologist prior to use.
Nitrofurantoin	4.4–5 mg/kg PO q8h	Good second-line option for simple uncomplicated UTI, particularly when multidrug-resistant pathogens are involved.
Orbifloxacin	Tablets: 2.5–7.5 mg/kg PO q24h; oral suspension: 7.5 mg/kg PO q24h (cats) or 2.5–7.5 mg/kg PO q24h (dogs)	Excreted in urine predominantly in active form.

# COMPLICATED UTI – Therapy

## Duration

- No consensus, case based => clinical signs, urinalysis, urine culture
- 4 weeks in general
- 2 weeks for non-recurrent, complicated UTIs, e.g., first occurrence in a diabetic
- (6-8 weeks plus for prostatitis)

# COMPLICATED UTI – Therapy

## Monitoring

- Urine culture via cystocentesis 5 to 7 days after starting therapy
- Culture urine 7 days after cessation of therapy
- Culture urine three weeks after administration of last dose of ceftiofexim
- If culture positive after or during therapy, reassess aggressively for underlying disease processes, consider referral/consultation

# Preventative measures / ancillary therapies

- **Cranberry extract / proanthocyanidins**
- Alters the expression of fimbriae, inhibits E coli adherence (human data)
- Can prevent but not treat UTI in people
- Confirm higher concentration of proanthocyanidins



# Pulse (intermittent) or chronic antibiotic therapy - insufficient evidence

*Personal experience with pulse therapy*

- Reserved for symptomatic or high risk patients with careful consideration to resistance
- Only attempted if underlying cause is addressed
- Urine culture and susceptibility with complete urinalysis before therapy, then every month – essential

# Pulse (intermittent) or chronic antibiotic therapy - insufficient evidence

*Personal experience with pulse therapy*

- Pick drug which is unlikely to cause adverse effects and is excreted in high concentration in urine
- May use a cephalosporin, b-lactam or fluoroquinolone
- Dosing: 1/3 daily therapeutic dose, give at bed time (goal of retention in bladder 6-8 hours)
- Therapy is guided by culture: if negative, continue for 6 months; change antibiotic based on culture
- Discontinue if negative culture and inactive urine sediment after 6 months

# Subclinical bacteriuria

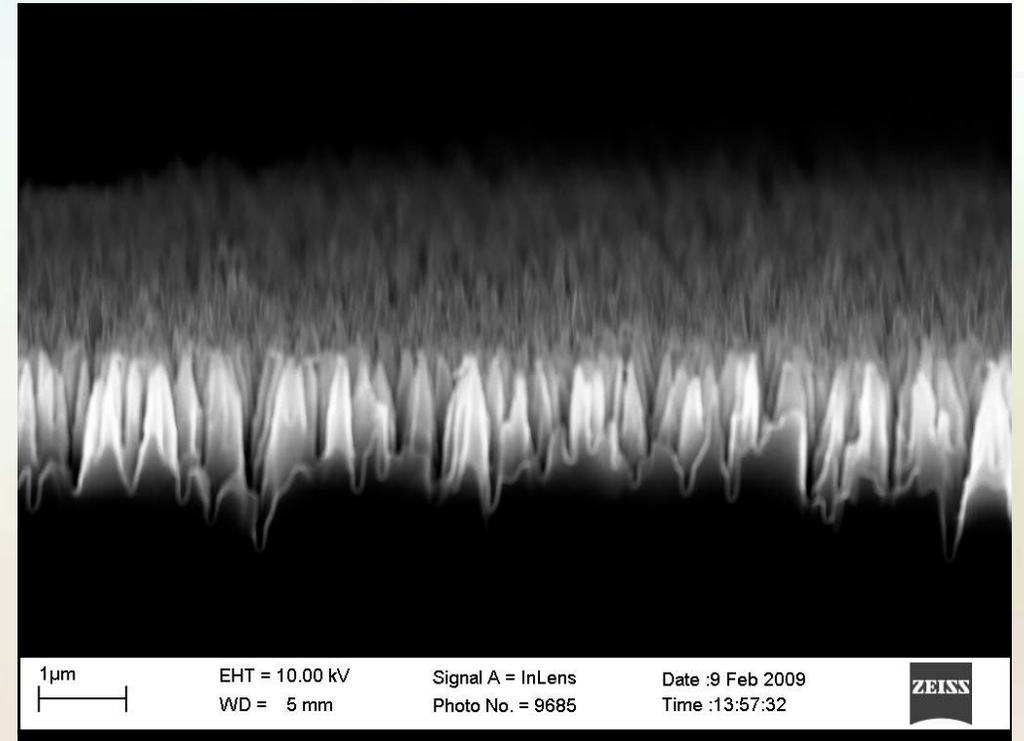
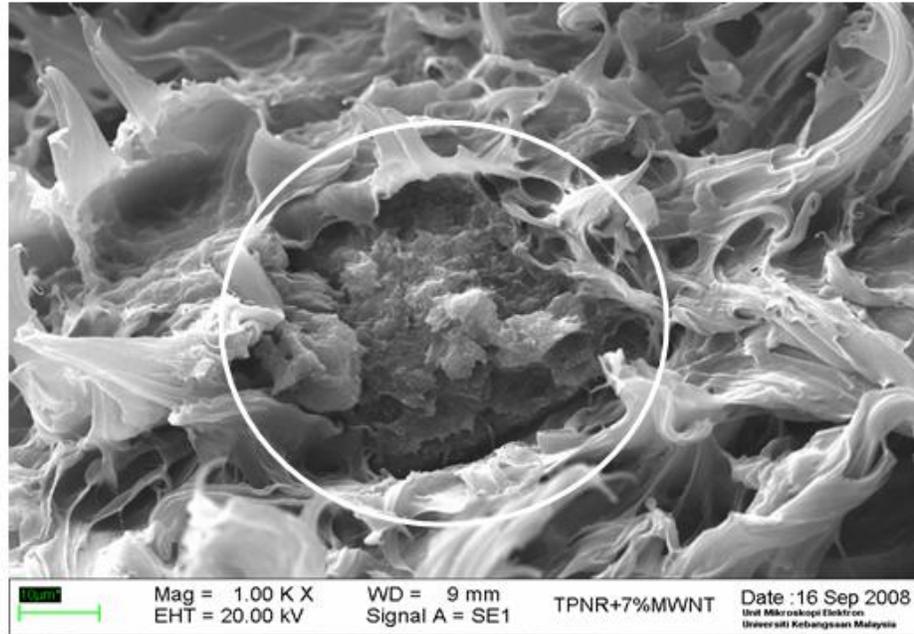
- No treatment if no clinical signs, urine sediment inactive
- Consider treatment if high risk of ascending or systemic infection (immunocompromised or patient with renal disease AND manage underlying cause)
- MDR bacteria - consider not treating if asymptomatic
- Bacteria may be replaced by susceptible organisms
- Susceptibility pattern may change over time

# Animals with urinary catheters: no clinical signs of infection

- No clinical signs\* – culture not recommended
- Not necessary to treat bacteriuria in absence of clinical or cytological evidence of infection
- Prophylactic antimicrobial therapy not recommended
- Silicone catheter is preferred over latex to prevent catheter-associated biofilm accumulation

## Latex vs. Silicone Surface:

Scanning electron microscope images show that latex surfaces are more irregular and promote microbial adherence



# Animals with urinary catheters: when urinary catheter is being removed

- No evidence that catheter tip culture results are predictive of developing a catheter associated UTI
- No evidence to support routine culture of urine after catheter removal
- Consider urine culture in patient at risk for UTI in which UTI implications are high



## Animals with urinary catheters: with clinical signs (FUO, active sediment)

- Submit culture of second draw of 5 ml through a new catheter
- Cystocentesis after catheter removal or between catheter replacement is preferred if feasible
- Do not culture urine from collection bag
- Recommend against culture of urinary catheter tip after removal



# Animals with urinary catheters: with clinical signs (FUO, active sediment)

## Treatment:

- Best success rates if catheter is removed
- Treat as an uncomplicated UTI if no comorbidities



# Upper urinary tract infections (pyelonephritis) - Diagnosis

- Culture urine via cystocentesis preferred, catheter acceptable
- Antimicrobial breakpoints for serum rather than urine concentration when available
- Assess relevance of organism: bacterial species and colony counts



# Upper urinary tract infections (pyelonephritis) - Treatment

- Start therapy immediately
- Culture blood, effusion and urine
- Select an antibiotic with efficacy against Gram-negative *Enterobacteriaceae*
- Select antibiotic excreted in the urine in the active form as a first choice, e.g. a fluoroquinolone



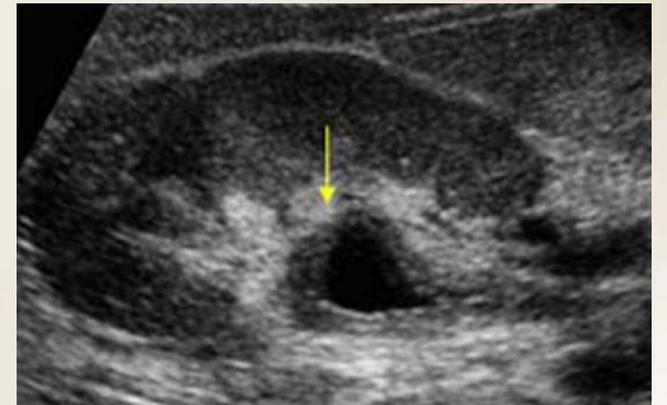
# Upper urinary tract infections (pyelonephritis) - Treatment

- Modify antibiotic therapy based on culture results
- Discontinue antibiotic if resistance is documented if a drug combination is given
- Change drugs if response to therapy is not sufficient
- Treat as for a complicated UTI with 4 weeks of therapy



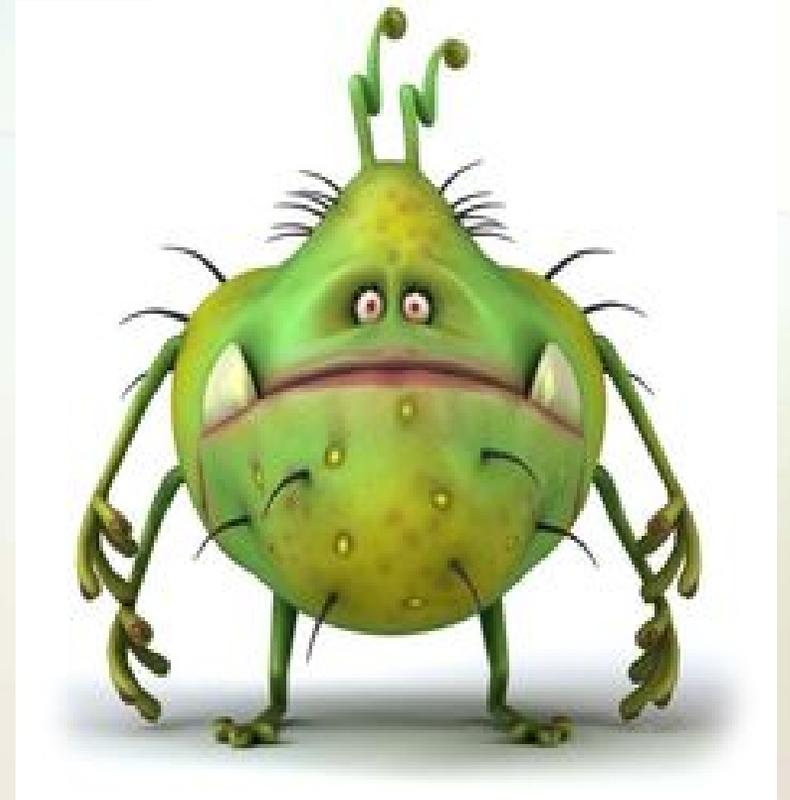
# Upper urinary tract infections (pyelonephritis) - Monitoring

- Urinalysis and culture 1 week after starting
- Urinalysis and culture 2 week after completing therapy
- If polymicrobial infection persists, consider consultation to assess the relative clinical relevance of each infectious agent and modify therapy as appropriate
- Treatment change may *not* be indicated if the primary pathogen has been eliminated



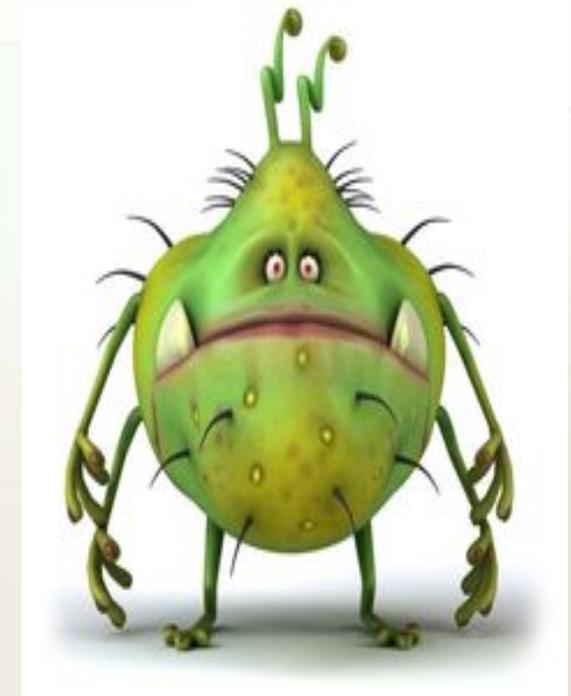
# Multidrug-Resistant Infections

- Commonly: *Enterobacteriaceae*, staphylococci, enterococci
- Challenges entail: limited drug choices, zoonotic potential, use of antimicrobials which are critically important in human medicine



# Vancomycin, carbopenems and linezolid would only be used if:

1. Clinical and cytological abnormalities are present and culture (cystocentesis) is performed; do not use for subclinical infection
2. Resistance to all other reasonable options and susceptibility to the antimicrobial is documented



# Vancomycin, carbopenems and linezolid would only be used if:

3. The infection must be potentially treatable, e.g. when the underlying cause has been eliminated
4. Other viable options have been assessed in consultation with a specialist



# ACVIM MDR Consensus Statement

- Voluntary drug use restriction preferred over legislative
- On-label use is not equivalent to prudent use
- Pulse antibiotic therapy is to be avoided and must be used in conjunction with comprehensive investigation of underlying causes and use of other preventative measures
- Discourages use of antimicrobials for nonantimicrobial activity, e.g. doxycycline as an anti-inflammatory for rhinitis or polyarthropathy



# Urine Culture (cystocentesis) 7/6/2011

## Escherichia coli > 100,000 CFU/ml

- Amoxicillin Resistant ( $\geq 32$  ug/ml)
- Amoxicillin / Clavulanic Acid Resistant ( $\geq 32$  ug/ml)
- Piperacillin Resistant
- **Imipenem Sensitive** ( $\leq 1$  ug/ml)
- Cephalexin Resistant ( $\geq 64$  ug/ml)
- Cefovecin Resistant
- Cefpodoxime Resistant ( $\geq 8$  ug/ml)
- Ceftiofur Resistant ( $\geq 8$  ug/ml)
- **Amikacin Sensitive** ( $\leq 2$  ug/ml)
- **Gentamicin Sensitive** ( $\leq 1$  ug/ml)
- **Tobramycin Sensitive** ( $\leq 1$  ug/ml)
- Ciprofloxacin Resistant
- Enrofloxacin Resistant ( $\geq 4$  ug/ml)
- Marbofloxacin Resistant ( $\geq 4$  ug/ml)
- **Tetracycline Sensitive** (2 ug/ml)
- **Nitrofurantoin Sensitive** ( $\leq 16$  ug/ml)
- **Chloramphenicol Intermediate** (16 ug/ml)
- **Trimethoprim-sulfa a Sensitive** ( $\leq 20$  ug/ml)



# Urine Culture (cystocentesis) 4/20/12

## Escherichia coli > 100,000 CFU/ml

- Amoxicillin Resistant ( $\geq 32$  ug/ml)
- Amoxicillin / Clavulanic Acid Resistant ( $\geq 32$  ug/ml)
- Piperacillin Resistant
- **Imipenem Sensitive** ( $\leq 1$  ug/ml)
- Cephalexin Resistant ( $\geq 64$  ug/ml)
- Cefovecin Resistant
- Cefpodoxime Resistant ( $\geq 8$  ug/ml)
- Ceftiofur Resistant ( $\geq 8$  ug/ml)
- **Amikacin Sensitive** ( $\leq 2$  ug/ml)
- **Gentamicin Sensitive** ( $\leq 1$  ug/ml)
- **Tobramycin Sensitive** ( $\leq 1$  ug/ml)
- Ciprofloxacin Resistant
- Enrofloxacin Resistant ( $\geq 4$  ug/ml)
- Marbofloxacin Resistant ( $\geq 4$  ug/ml)
- Tetracycline Resistant (2 ug/ml)
- Nitrofurantoin Intermediate ( $\leq 16$  ug/ml)
- **Chloramphenicol Intermediate** (16 ug/ml)
- **Trimethoprim-sulfa a Sensitive** ( $\leq 20$  ug/ml)



# Urine Culture (cystocentesis) 11/8/2013

## Enterococcus > 100,000 CFU/ml

- Amoxicillin Sensitive ( $\leq 2$  ug/ml)
- Amoxicillin / Sensitive
- Clavulanic Acid
- Imipenem Sensitive ( $\leq 1$  ug/ml)
- Gentamicin Synergy Sensitive (SYN-S ug/ml)
- Ciprofloxacin Sensitive
- Enrofloxacin Sensitive ( $\leq 0.5$  ug/ml)
- Marbofloxacin Sensitive (1 ug/ml)
- Azithromycin Intermediate
- Erythromycin Intermediate (2 ug/ml)
- Doxycycline Sensitive
- Tetracycline Sensitive ( $\leq 1$  ug/ml)
- Nitrofurantoin Sensitive ( $\leq 16$  ug/ml)
- Chloramphenicol Sensitive ( $\leq 4$  ug/ml)



# Urine Culture (cystocentesis) 9/17/2014

## Escherichia coli > 100,000 CFU/ml

- Amoxicillin Sensitive (4 ug/ml)
- Amoxicillin / Clavulanic Acid Sensitive (<=2 ug/ml)
- Ticarcillin / Clavulanic Acid Sensitive
- Piperacillin Sensitive (<=4 ug/ml)
- Imipenem Sensitive (<=1 ug/ml)
- Cephalexin Sensitive (8 ug/ml)
- Cefovecin Sensitive (1 ug/ml)
- Cefpodoxime Sensitive (<=0.25 ug/ml)
- Cefotaxime Sensitive
- Ceftazidime Sensitive
- Ceftiofur Sensitive (<=1 ug/ml)
- Amikacin Sensitive (<=2 ug/ml)
- Gentamicin Sensitive (<=1 ug/ml)
- Tobramycin Sensitive (<=1 ug/ml)
- Ciprofloxacin Sensitive
- Enrofloxacin Sensitive (<=0.12 ug/ml)
- Marbofloxacin Sensitive (<=0.5 ug/ml)
- Tetracycline Sensitive (<=1 ug/ml)
- Nitrofurantoin Sensitive (32 ug/ml)
- Chloramphenicol Sensitive (8 ug/ml)
- Trimethoprim-sulfa Sensitive (<=20 ug/ml)

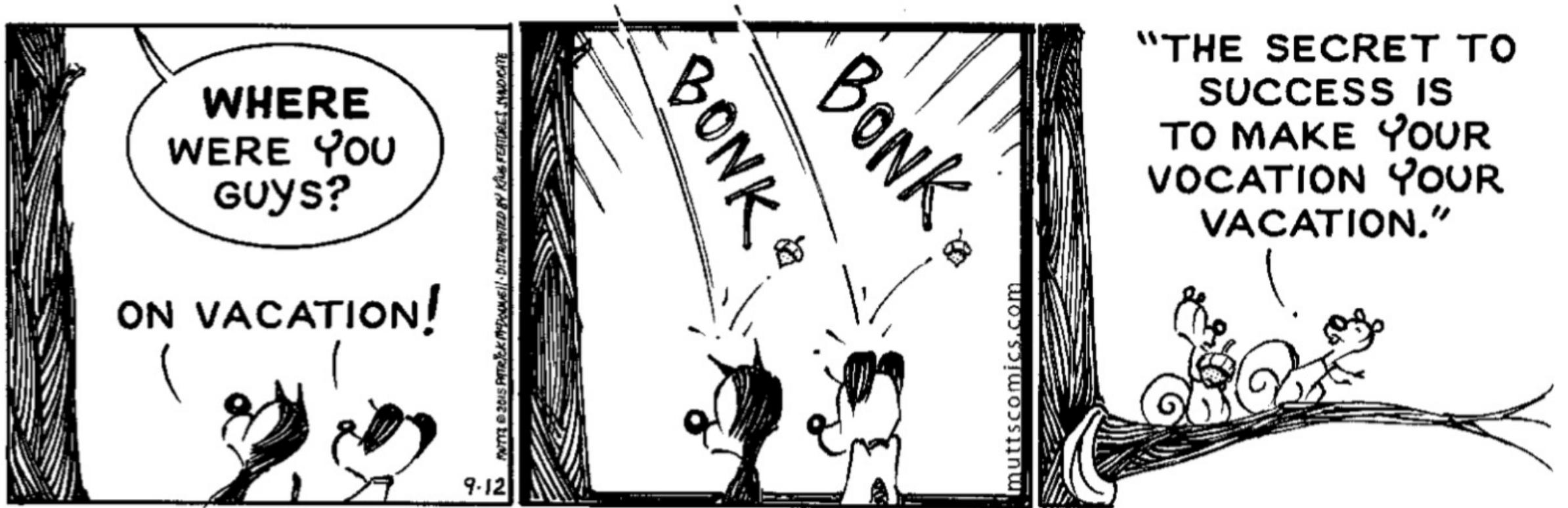


# Urine Culture (cystocentesis)

- 3/31/2015 (Order Received)
- **NO AEROBIC GROWTH**

# Summary of first-line antimicrobial options for UTIs in the dog and cat

Infection Type	First-line drug options
Uncomplicated UTI	Amoxicillin, trimethoprim-sulfonamide
Complicated	Guided by culture and susceptibility testing, but consider amoxicillin or trimethoprim-sulfonamide initially
Subclinical bacteriuria	Antimicrobial therapy not recommended unless high risk for ascending infection. If so, treat as per complicated UTI
Pyelonephritis	Start with a fluoroquinolone, with re-assessment based on culture and susceptibility testing



- Questions or thoughts to share? Contact me any time!
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