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

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

Available at: dx.doi.org/10.4061/2011/263768.
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-Minami, 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
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 commensal’s 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


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 - Fluoroquinolone 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.
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
COMPPLICATED UTI – Therapy

see Web-published Handout

Veterinary Medicine International

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

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>11–15 mg/kg PO q4h</td>
<td>Good first-line option for UTI. Exceeded in utero; predominantly in active form if normal renal function is present. No irritating effect seen. Produces beta-lactamase-producing bacteria.</td>
</tr>
<tr>
<td>Amoxicillin/Clavulanic acid</td>
<td>12.5–25 mg/kg PO q4h (close based on combination of amoxicillin + clavulanic acid)</td>
<td>Not established whether there is any advantage over amoxicillin alone.</td>
</tr>
<tr>
<td>Ampicillin</td>
<td></td>
<td>Not recommended because of poor oral bioavailability. Amoxicillin is preferred.</td>
</tr>
<tr>
<td>Cephalexin</td>
<td>12–25 mg/kg PO q12h</td>
<td>Renal excretion. Resistance may be common in Escherichia coli.</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>8–12 mg/kg single SC injection. Can be repeated once after 7–14 days.</td>
<td>Should only be used in situations where oral treatment is impractical, particularly in patients with impaired renal function. Uses cefazolin. Data are available to support the use in dogs and cats, with a duration of 3–5 days (dogs) and 7–10 days (cats). The duration of treatment in the urinary tract makes it difficult to interpret posttreatment culture results.</td>
</tr>
<tr>
<td>Cefapentine</td>
<td>15–30 mg/kg PO q12h</td>
<td>Enterococci are resistant. Resistance may be common in Enterobacteriaceae in some regions.</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>500 mg PO q6h</td>
<td>Not recommended because of poor oral bioavailability. Resistance may be common in Enterobacteriaceae in some regions.</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>2–4 mg/kg q24h</td>
<td>Should only be used in situations where oral treatment is impractical. These preparations can cause, particularly in cats, long-term therapy. Avoid contact by humans because of rare allergic reactions.</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>5–8 mg/kg PO q12h</td>
<td>Sometimes used because of lower cost than ciprofloxacin. Lower and more variable oral bioavailability than ciprofloxacin.</td>
</tr>
<tr>
<td>Enrofloxacin</td>
<td>5–10 mg/kg PO q12h</td>
<td>Sometimes used because of lower cost than ciprofloxacin. Lower and more variable oral bioavailability than ciprofloxacin.</td>
</tr>
<tr>
<td>Imipenem/clindamycin</td>
<td>3–5 mg/kg IV q6h (dog)</td>
<td>Reserve for treatment of multidrug-resistant infections, particularly those caused by Enterococcus or Pseudomonas aeruginosa. Recommended consultation with a urinary tract infection disease veterinarian specialist or veterinary pharmacologist prior to use.</td>
</tr>
<tr>
<td>Meropenem</td>
<td>5.27–3.5 mg/kg PO q24h</td>
<td>Excited in urine predominantly to active form. Good second-line option for multidrug-resistant UTI. Absorption excellent. Limited toxicity against enteric infections.</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>6.5 mg/kg SC q72h (SC) or qIV q24h</td>
<td>Reserve for treatment of multidrug-resistant infections, particularly those caused by Enterococcus or Pseudomonas aeruginosa. Recommended consultation with a urinary tract infection disease veterinary specialist or veterinary pharmacologist prior to use.</td>
</tr>
<tr>
<td>Nitrofurantoin</td>
<td>4–8 mg/kg PO q12h</td>
<td>Good second-line option for uncomplicated UTI, particularly when multidrug-resistant pathogens are involved.</td>
</tr>
<tr>
<td>Oroflaxacin</td>
<td>Tablets 2–3.25 mg/kg PO q12h; oral suspension 1–3.25 mg/kg PO q12h (cat) or 2.5–3.75 mg/kg PO q24h (dog).</td>
<td>Excited in urine predominantly to active form.</td>
</tr>
</tbody>
</table>
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 cefovecin
- If culture positive after or during therapy, reassess aggressively for underlying disease processes, consider referral/consultation
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, β-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 (>=32 ug/ml)
- Amoxicillin / Clavulanic Acid Resistant (>=32 ug/ml)
- Piperacillin Resistant
- **Imipenem Sensitive** (<=1 ug/ml)
- Cephalexin Resistant (>=64 ug/ml)
- Cefovecin Resistant
- Cefpodoxime Resistant (>=8 ug/ml)
- Ceftiofur Resistant (>=8 ug/ml)
- **Amikacin Sensitive** (<=2 ug/ml)
- **Gentamicin Sensitive** (<=1 ug/ml)
- **Tobramycin Sensitive** (<=1 ug/ml)
- Ciprofloxacin Resistant
- Enrofloxacin Resistant (>=4 ug/ml)
- Marbofloxacin Resistant (>=4 ug/ml)
- **Tetracycline Sensitive** (2 ug/ml)
- **Nitrofurantoin Sensitive** (<=16 ug/ml)
- **Chloramphenicol Intermediate** (16 ug/ml)
- **Trimethoprim-sulfa a Sensitive** (<=20 ug/ml)
Urine Culture (cystocentesis) 4/20/12
Escherichia coli > 100,000 CFU/ml

- Amoxicillin Resistant (>=32 ug/ml)
- Amoxicillin / Clavulanic Acid Resistant (>=32 ug/ml)
- Piperacillin Resistant
- **Imipenem Sensitive** (<=1 ug/ml)
- Cephalexin Resistant (>=64 ug/ml)
- Cefovecin Resistant
- Cefpodoxime Resistant (>=8 ug/ml)
- Ceftiofur Resistant (>=8 ug/ml)
- **Amikacin Sensitive** (<=2 ug/ml)
- **Gentamicin Sensitive** (<=1 ug/ml)
- **Tobramycin Sensitive** (<=1 ug/ml)
- Ciprofloxacin Resistant
- Enrofloxacin Resistant (>=4 ug/ml)
- Marbofloxacin Resistant (>=4 ug/ml)
- Tetracycline Resistant (2 ug/ml)
- Nitrofurantoin Intermediate (<=16 ug/ml)
- **Chloramphenicol Intermediate** (16 ug/ml)
- **Trimethoprim-sulfa a Sensitive** (<=20 ug/ml)
<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>Sensitive (&lt;=2 ug/ml)</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>/ Sensitive</td>
</tr>
<tr>
<td>Clavulanic Acid</td>
<td></td>
</tr>
<tr>
<td>Imipenem</td>
<td>Sensitive (&lt;=1 ug/ml)</td>
</tr>
<tr>
<td>Gentamicin Synergy</td>
<td>Sensitive (SYN-S ug/ml)</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Enrofloxacin</td>
<td>Sensitive (&lt;=0.5 ug/ml)</td>
</tr>
<tr>
<td>Marbofloxacin</td>
<td>Sensitive (1 ug/ml)</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>Intermediate</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>Intermediate (2 ug/ml)</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>Sensitive</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>Sensitive (&lt;=1 ug/ml)</td>
</tr>
<tr>
<td>Nitrofurantoin</td>
<td>Sensitive (&lt;=16 ug/ml)</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>Sensitive (&lt;=4 ug/ml)</td>
</tr>
</tbody>
</table>

Urine Culture (cystocentesis) 11/8/2013
Enterococcus > 100,000 CFU/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 / Sensitive
- Clavulanic Acid
- 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

<table>
<thead>
<tr>
<th>Infection Type</th>
<th>First-line drug options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncomplicated UTI</td>
<td>Amoxicillin, trimethoprim-sulfonamide</td>
</tr>
<tr>
<td>Complicated</td>
<td>Guided by culture and susceptibility testing, but consider amoxicillin or trimethoprim-sulfonamide initially</td>
</tr>
<tr>
<td>Subclinical bacteriuria</td>
<td>Antimicrobial therapy not recommended unless high risk for ascending infection. If so, treat as per complicated UTI</td>
</tr>
<tr>
<td>Pyelonephritis</td>
<td>Start with a fluoroquinolone, with re-assessment based on culture and susceptibility testing</td>
</tr>
</tbody>
</table>
• Questions or thoughts to share? Contact me any time!
• Sybille Miller, 703-777-5866; TLC.LVIM@gmail.com