Your Presenter

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Tick-borne Disease Testing

Special thanks to Dr. Stephen Barr
Tick-borne Disease Testing

When do you test dogs at your shelter for tick-borne diseases?

- A – We do not perform testing on any dogs
- B – Testing limited to suspected cases
- C – Screening of some dogs
- D – Screening of all dogs
Tick-borne Disease Testing

What do you do with positive results?

• A – Try to ignore them
• B – Assume they are correct
• C – Perform additional testing
• D – Provide treatment
• E – Some combination of the above
Our Goal for Today

- Provide a brief overview of:
  - Factors influencing test interpretation
  - Each disease included in common point-of-care assays for tick-borne disease
  - What to do with positive results

- Give you tools to assess your shelter’s protocols
Tick-borne Disease Testing

- Lyme Disease (*Borrelia burgdorferi*)
- *Anaplasma* spp.
- *Ehrlichia* spp.

- *Babesia* spp.
- *Hepatazoon canis*
- Rocky Mountain Spotted Fever (*Rickettsia rickettii*)
What does that result really mean?

- You get a test result back. Does that mean it’s correct?
- How useful, or credible, is that test at telling you what you’re looking to know?
## Inherent Limitations

<table>
<thead>
<tr>
<th></th>
<th>Antigen tests</th>
<th>Antibody tests</th>
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</thead>
<tbody>
<tr>
<td><strong>False negatives</strong></td>
<td>• Early/late or low-level infections</td>
<td>• Compromised immune function</td>
</tr>
<tr>
<td></td>
<td>• Antigen-antibody complexes</td>
<td>• Early/late infections</td>
</tr>
<tr>
<td></td>
<td>• Antigen not in sample tested</td>
<td></td>
</tr>
<tr>
<td><strong>False positives</strong></td>
<td>• Contamination</td>
<td>• Vaccination or maternal antibody interference</td>
</tr>
<tr>
<td></td>
<td>• Cross-reactivity</td>
<td>• Cross-reactivity</td>
</tr>
</tbody>
</table>
Testing Limitations

One of the biggest limitations?

3. Find x.

Here it is
Sensitivity & Specificity

- Sensitivity = how good the test is at identifying affected animals
  - Highly sensitive tests correctly identify all or nearly all affected animals, with few false negatives

- Specificity = how good the test is at not misidentifying healthy animals as affected
  - Highly specific tests correctly identify only those animals actually affected, with few false positives
Predictive Values

- Predictive value = usefulness of the test in classifying animals with and without the disease

- How trustworthy are your results?

- Remember – no test is perfect!
Small changes can have a big impact on your results – especially if you are testing many animals.
Ehrlichia spp.

Gram negative obligate intracellular bacteria

- *E. canis* vectored by *Rhipicephalus*
- *E. ewingii* and *E. chaffeensis* mainly by *Amblyoma*

Acute, subclinical and chronic disease may occur

Cases year-round, peak in summer
https://www.capcvet.org/maps/#2017/all/ehrlichiosis/dog/united-states/
Ehrlichia spp.

Clinical findings vary by species:

- *E. canis* – lethargy, fever, anorexia, weight loss, bleeding tendencies, enlarged lymph nodes and/or spleen

- *E. chaffeensis* – bloody nose, enlarged lymph nodes, ocular signs, vomiting

- *E. ewingii* – fever, anorexia, stiffness/joint swelling, neurologic signs
Ehrlichia - Diagnostics

Positive results indicate exposure

- Treatment of asymptomatic dogs solely on basis of positive screening NOT recommended

- Additional testing to determine active infection
Ehrlichia + Result: Next Steps

Identify any co-infections

Look for evidence of active infection:

- Consistent history and clinical signs
- Low white blood cell counts, especially low platelets; high protein levels, elevated liver enzymes, prolonged bleeding times, blood or protein in the urine
- Morulae in buffy coat blood smears or aspirates
- Real-time PCR: blood vs. splenic aspirates
Treatment of Ehrlichiosis

Antibacterial agents and supportive care

• Doxycycline for 4 weeks
• Response in 24-48 hours, platelets normal w/in 14 days
• Chronically infected dogs may be poorly responsive

• May not clear infection

• Reinfection possible
Lyme Disease

- Disease caused by a bacterium called *Borrelia burgdorferi*
- First human case → Lyme, Connecticut (1975)
- Increasingly problematic for humans and dogs
How do dogs get infected?

- Tick bite → *Ixodes scapularis* (~24-48 hours)

- In endemic areas high proportions of ticks are infected
Lyme Disease

- Up to 70% of dogs in certain places in the Northeast have been infected.

- Unfortunately, don’t generally know how many dogs are infected in a specific area, but do know that it follows numbers in people.
What does it do to dogs?

- 1. **Nothing!!** Only about 5% of infected dogs ever show signs!!
- 2. **Arthritis**, fever, feeling “off,” limb pain – 2 to 5 mo after infection
- 3. **Kidney Disease** → VERY RARE → mainly affects certain breeds of dogs
Diagnosis

Criteria:

1. History of exposure to ticks in an endemic area
2. Typical clinical signs for Lyme borreliosis
3. Specific antibodies against *B. burgdorferi*
4. Prompt response to appropriate antibiotic therapy
Idexx 4DX™ Snap Test

- C6 antibody detection
  - Antibody made to infections, not vaccination
  - 2-3 wks post-infection
  - Drops 2-6 mo after treatment
  - No cross-reactivity with other diseases

- Asymptomatic dogs – titer magnitude doesn’t correlate with clinical signs (over 20 months)
To Treat or Not to Treat

- If Asymptomatic: Do NOT treat (ACVIM, CAPC)
  - Treating does decrease the titer quicker BUT there is no indication that it prevents future clinical signs or the development of kidney disease

- If Symptomatic (arthritis): TREAT
  - Quick response to disease – dogs feel better quicker
  - No indication that treatment will prevent future signs
If you do treat...

- Standard treatment is doxycycline for 30 days, may need to be longer for some dogs
- All antibiotic regimes have failed to clear organisms from the tissues of some dogs
- Clinical signs (acute arthritis, fever) should improve within 1-2 days of starting therapy
Anaplasmosis

- *Anaplasma phagocytophilum*
  - Northeast, upper mid-west, California
  - Vectors:
    - *Ixodes scapularis* (Northeast)
    - *Ixodes pacificus* (California)

- *Anaplasma platys*
  - Texas, Oklahoma, Florida
  - Vector:
    - *Rhipicephalus sanguineus*
Anaplasmosis

- Infects certain white blood cells
- Not known how cause disease
- 10 days post-infection → strong immunity usually controls infection
- 1-3 week incubation period
- Acute disease only (if at all) – **no chronic disease**
Clinical Signs - Anaplasma

- Middle aged dogs
  - Spring, summer, early fall
- Fever, lethargy, anorexia
- Polyarthritis: pain/stiffness – lameness rare (10%)
- Low platelet counts, but bleeding does not occur
- Dogs infected with both Lyme and Anaplasma show more severe signs (lame)

Photo courtesy of Stephen Barr
4DX Anaplasma

- Cross reaction
  - *A. platys*
  - Slight with *E. canis* during acute infection (but less during convalescences)
  - None with Lyme or RMSP

- Positive result in west/northeast → *A. phagocytophilum*

- Positive result in southeast → *A. platys*
Treat a positive or not??

- If symptomatic (with typical CBC changes)
  - Doxycycline for 4 weeks
  - *Anaplasma* spp are also susceptible to enrofloxacin

- **Remember** → this case is likely to also have a slightly positive *E. canis* dot
Treat a positive or not??

- If **asymptomatic**
  - No chronic disease = no point in treating
  - Consider treating if also Lyme positive, or wait until clinical signs develop
Pulling It All Together

Positive results in healthy dogs:

- Ehrlichia – additional testing, treat if confirmed
- Lyme – probably nothing further
- Anaplasma – probably nothing further
What does this mean for us?
Evaluating Your Protocols

• What is your testing protocol?
• Estimated prevalence of disease?
• What test kit do you use?
• What is the reported sensitivity? Specificity?
• What do you do with positive results? Negative?
• Animals tested/year?
• Cost per test?
• What’s the PPV and NPV?
• What is the ‘cost’ of the results?
• Other considerations
<table>
<thead>
<tr>
<th>Disease</th>
<th>Test kit</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heartworm</td>
<td><strong>VetScan Canine Heartworm</strong></td>
<td>92.0%</td>
<td>100.0%</td>
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<tr>
<td></td>
<td><strong>Enhanced Witness HW</strong></td>
<td>96.6%</td>
<td>96.6%</td>
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<tr>
<td></td>
<td><strong>SoloStep</strong></td>
<td>95.0%</td>
<td>99.0%</td>
</tr>
<tr>
<td>Low worm burdens</td>
<td><strong>SoloStep</strong></td>
<td>62%, 85%, 88%</td>
<td></td>
</tr>
<tr>
<td>(1, 2, or 3 worms)</td>
<td><strong>SNAP Heartworm RT</strong></td>
<td>64%, 88%, 94%</td>
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<tr>
<td></td>
<td><strong>VetScan Canine Lyme</strong></td>
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<td>100.0%</td>
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<tr>
<td></td>
<td><strong>IDEXX 4DX Plus</strong></td>
<td>96.7%</td>
<td>98.8%</td>
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<td>Ehrlichiosis</td>
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<td></td>
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<tr>
<td></td>
<td>E. ewingii</td>
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<td>Anaplasmosis</td>
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<tr>
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<td>A. platys</td>
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<tr>
<td></td>
<td>VetScan Canine Anaplasma</td>
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