

Good Bugs and Bad Bugs!



Brian Husbands, DVM, DACVIM (onc)
Associate Clinical Professor, Oncology



THE OHIO STATE UNIVERSITY

COLLEGE OF VETERINARY MEDICINE

Veterinary Medical Center | Integrated Oncology

The Other AWS

Already a Member? [Sign in here](#) or [Join now!](#)

Search this site



[About Us](#) [Learn & Discover](#) [Events](#) [Our Industry Partners](#) [Members \(Login Required\)](#) [Contact](#)



National Conference

DISCOVERY • OUTREACH • EDUCATION • SERVICE

Projects

AWS Alopecia Study – blood and photos

OFA CHIC DNA Repository – blood

Microbiome Study – OSU with Purdue

Microbiome

'01 – term used to describe all of the microorganisms that share our body with us

Bacteria (many species), Viruses, and Fungi

Skin, Respiratory Tract, Urinary Tract, and GI Tract

These are thought to be beneficial in most cases

What influences the make up of the microbiome and why do we care?

Environment

Diet


Exercise

Disease

Medications and supplements

Age

Likely many other factors

 Imbalance can potentially lead to health problems – numerous ongoing studies

Microbiome in Diseased States

In some human diseases, imbalances in the microbiome have been discovered, including cancers

What can we do to support a good microbiome?

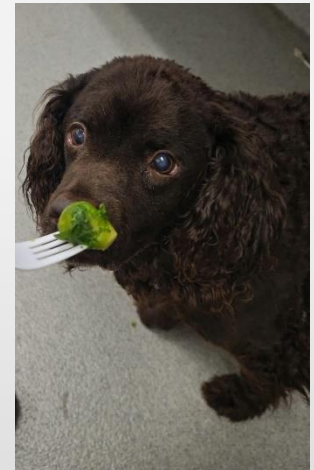
Prebiotics:

non-digestive carbohydrates in every day foods. Upon entering the colon, bacteria have the ability to break down.

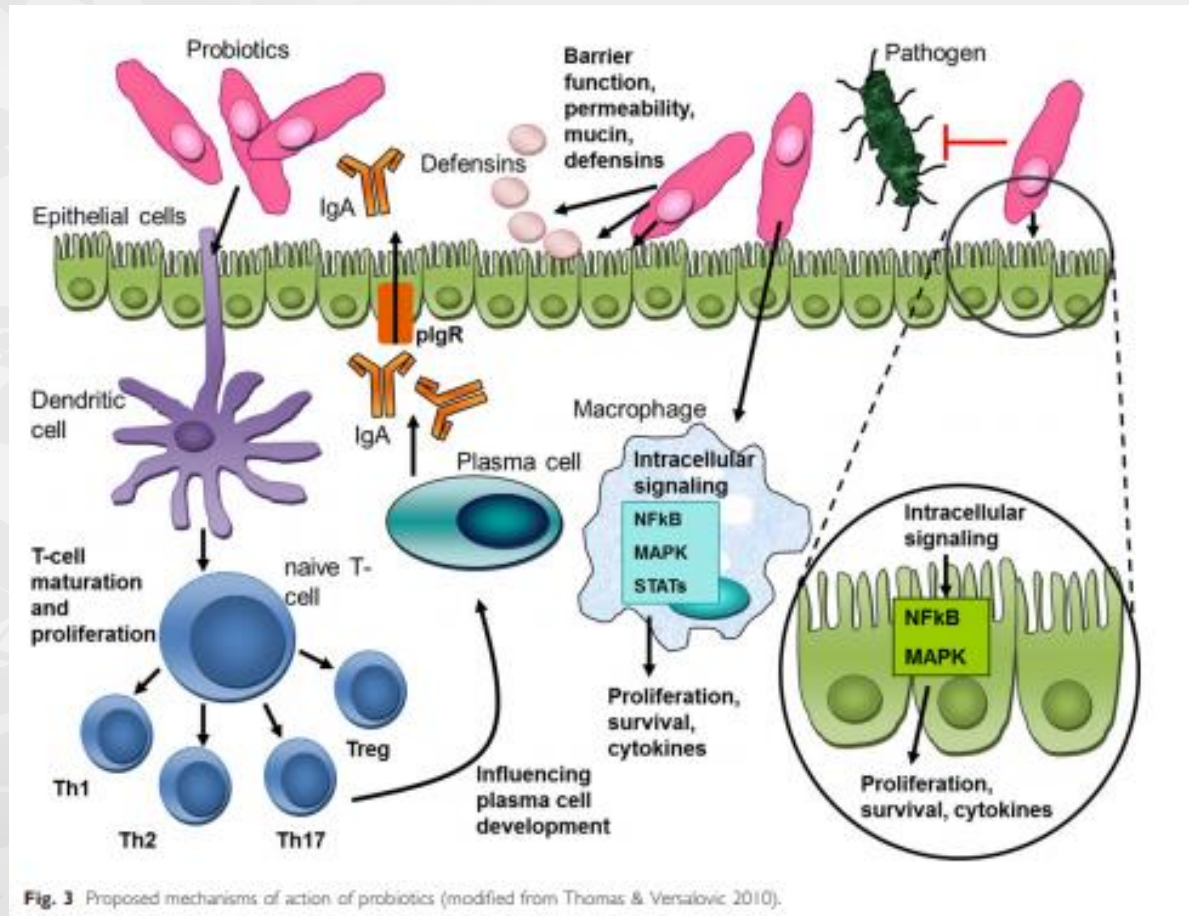
examples: bananas, apples, rolled oats, pumpkin, some vegetables, commercial fiber supplement

Probiotics:

examples: yogurt, slow cooked vegetables (sauerkraut, kimchi), probiotic supplements

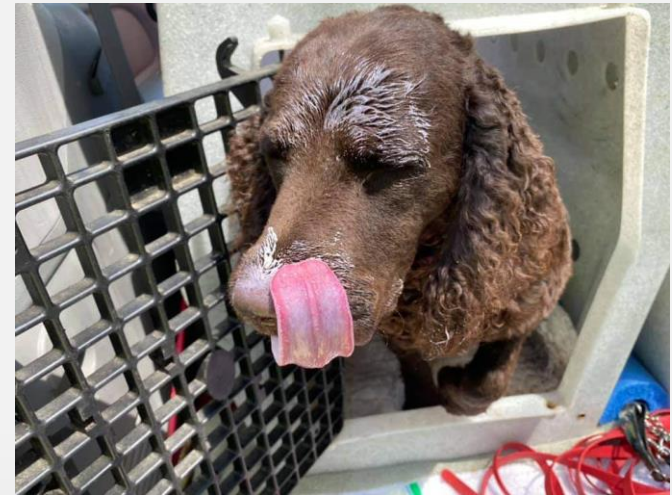


Probiotic Function



© 2016 The Authors. *Veterinary Medicine and Science* Published by John Wiley & Sons Ltd.
Veterinary Medicine and Science (2016), 2, pp. 71–94

Our dogs must know the benefits of probiotics!



Acute (short term) diarrhea in dogs

Many veterinarians will prescribe a probiotic (commercial supplement) and fiber supplement

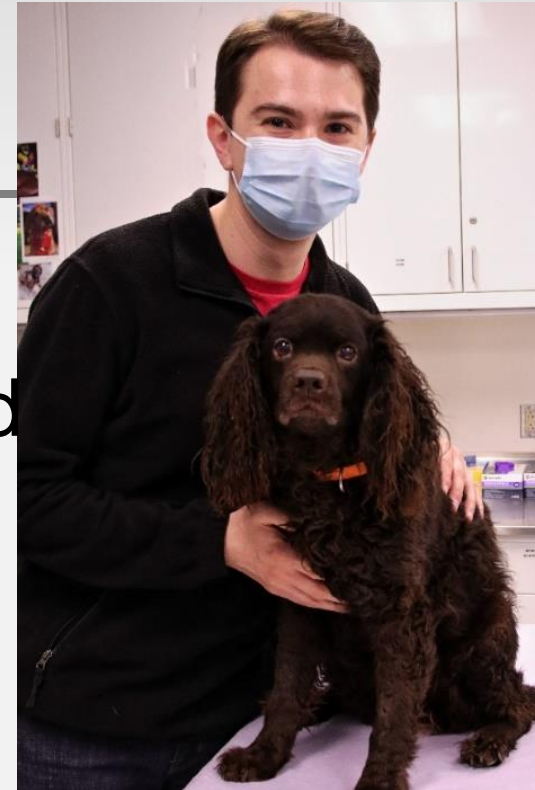


Our Project

Microbiome in dogs (Scotties) with bladder cancer (feces and urine) and those without.

We need a breed to compare these Scotties with.

Collaborating with Purdue University.



Our Project

Exclusion Criteria:

Antibiotics in the past 3 months

Some Supplements (Probiotics)

History of/or current urinary tract problems

What Is Needed?








Consent Form

Questionnaire

Score the Feces Sample (yuck)

Small Urine Sample and Small Sample of Feces

Scoring

SCORE	SPECIMEN EXAMPLE	CHARACTERISTICS
1		<ul style="list-style-type: none"> · Very hard and dry · Often expelled as individual pellets · Requires much effort to expel from body · Leaves no residue on ground when picked up
2	IDEAL 	<ul style="list-style-type: none"> · Firm, but not hard, pliable · Segmented in appearance · Little or no residue on ground when picked up
3		<ul style="list-style-type: none"> · Log shaped, moist surface · Little or no visible segmentation · Leaves residue on ground, but holds form when picked up
4		<ul style="list-style-type: none"> · Very moist and soggy · Log shaped · Leaves residue on ground and loses form when picked up
5		<ul style="list-style-type: none"> · Very moist but has a distinct shape · Present in piles rather than logs · Leaves residue on ground and loses form when picked up
6		<ul style="list-style-type: none"> · Has texture, but no defined shape · Present as piles or spots · Leaves residue on ground when picked up
7		<ul style="list-style-type: none"> · Watery · No texture · Present in flat puddles

Our Project



Otis

5 month old male Doodle

Presented to our emergency service for 2 days of lethargy and inappetance with multiple bouts of vomiting (July 17)

No known exposure to toxins and no changes in diet

Current on DA₂PP and *Bordetella* vacccs



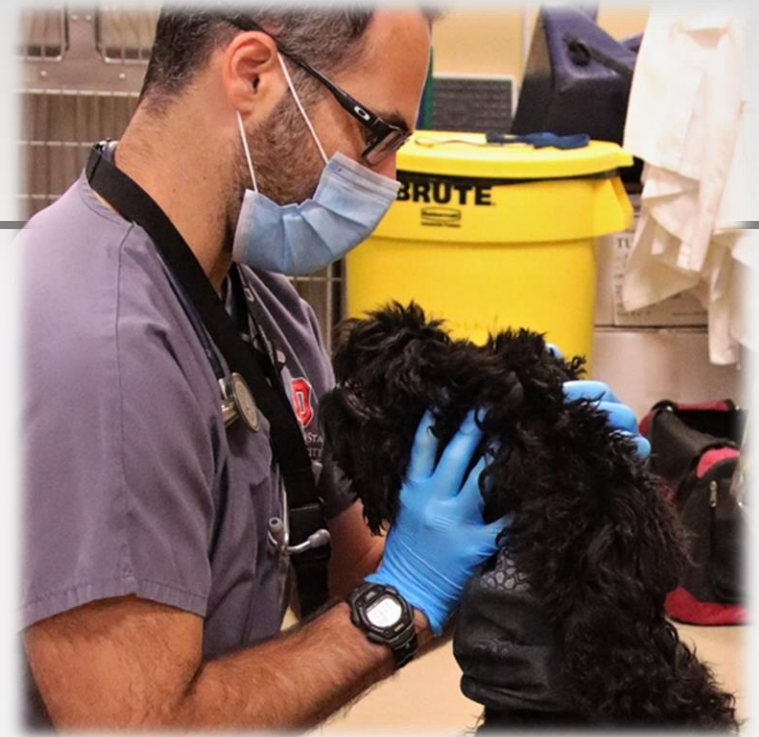
Otis

Vitals: normal

Exam:

Dehydrated

No other remarkable abnormalities



So, what were we thinking??

Testing

X-rays

Baseline bloodwork

blood cell counts

organ function testing (chemistry profile)

Urinalysis



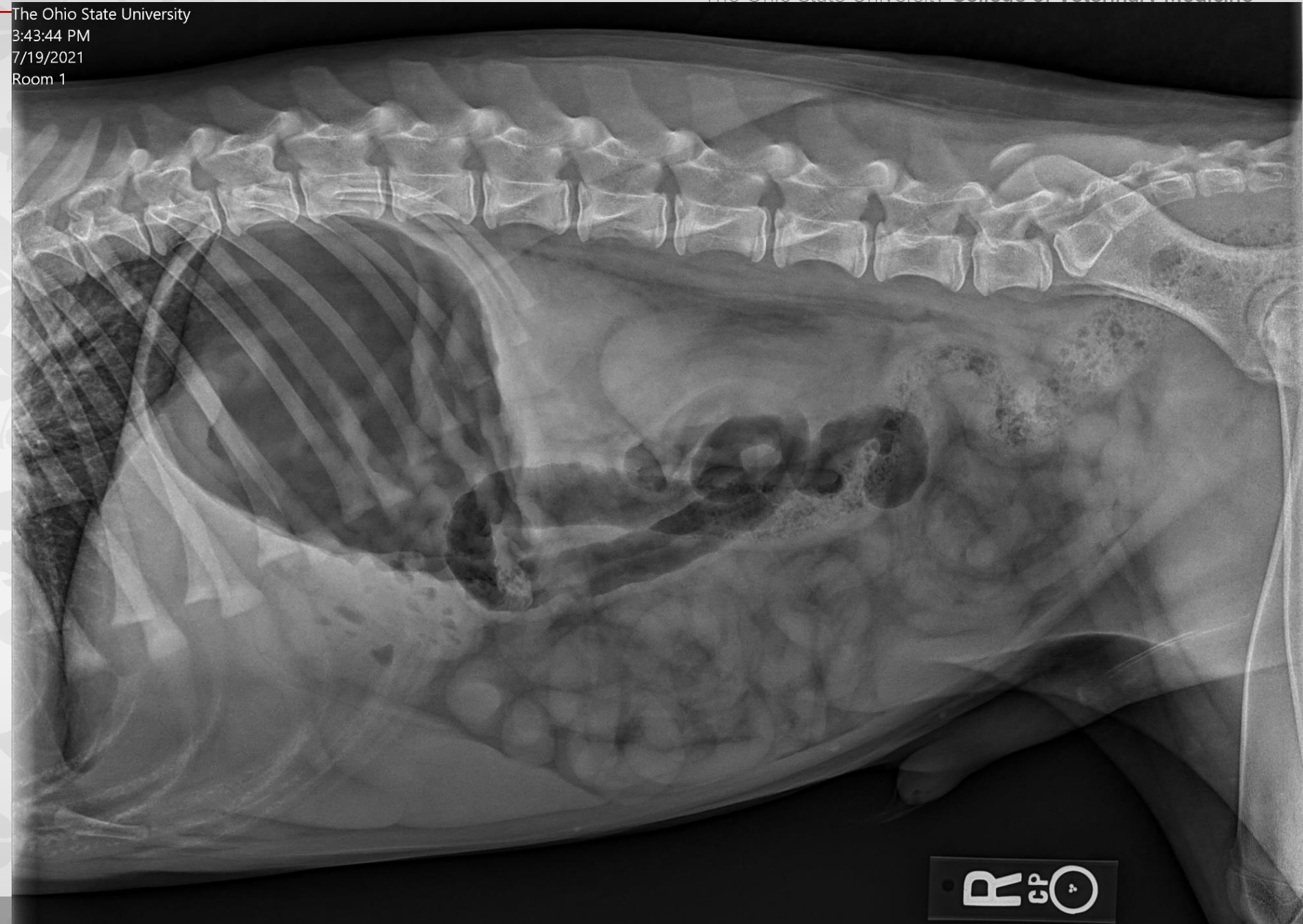


R
CP
○

The Ohio State University
3:40:55 PM
7/19/2021
Room 1



The Ohio State University
3:43:44 PM
7/19/2021
Room 1



Results

Blood cell counts – unremarkable

Urinalysis – very dilute urine

CHEMISTRY

Test: CH. Profile Minus Nova-Small Animal

Test	Result	Reference Interval
CH. Phosphorus (mg/dL)	11.0	2.2 - 6.3
CH. Calcium-Total (mg/dL)	12.3	9.1 - 11.5
CH. ALT -Alanine Amino Transferase (IU/L)	61.00	18.00 - 108.00
CH. AST-Aspartate Amino Transferase (IU/L)	155.00	16.00 - 51.00
CH. AP-Alkaline Phosphatase (IU/L)	784.00	12.00 - 133.00
CH. CK-Creatine Kinase (IU/L)	3791.00	53.00 - 372.00
CH. Cholesterol (mg/dL)	286.00	122.00 - 345.00
CH. Bilirubin-Total (mg/dL)	4.11	0.05 - 0.20
CH. Total Protein-Serum (g/dL)	5.10	5.10 - 7.10
CH. Albumin (g/L)	2.9	3.3 - 4.2
CH. Globulin (g/dL)	2.20	1.70 - 3.40
CH. A/G Ratio (g/dL)	1.32	1.00 - 2.20
CH. Lipemic Index	3	
CH. Hemolytic Index	39	
CH. Icteric Index	4	
CH. GGT (IU/L)	3.00	0.00 - 22.30
CH, BUN	70	6-30
CH, Creatinine	3.82	0.6-1.6

CHEMISTRY

Test: CH. Profile Minus Nova-Small Animal

Test	Result	Reference Interval
CH. Phosphorus (mg/dL)	11.0	2.2 - 6.3
CH. Calcium-Total (mg/dL)	12.3	9.1 - 11.5
CH. ALT -Alanine Amino Transferase (IU/L)	61.00	18.00 - 108.00
CH. AST-Aspartate Amino Transferase (IU/L)	155.00	16.00 - 51.00
CH. AP-Alkaline Phosphatase (IU/L)	784.00	12.00 - 133.00
CH. CK-Creatine Kinase (IU/L)	3791.00	53.00 - 372.00
CH. Cholesterol (mg/dL)	286.00	122.00 - 345.00
CH. Bilirubin-Total (mg/dL)	4.11	0.05 - 0.20
CH. Total Protein-Serum (g/dL)	5.10	5.10 - 7.10
CH. Albumin (g/L)	2.9	3.3 - 4.2
CH. Globulin (g/dL)	2.20	1.70 - 3.40
CH. A/G Ratio (g/dL)	1.32	1.00 - 2.20
CH. Lipemic Index	3	
CH. Hemolytic Index	39	
CH. Icteric Index	4	
CH. GGT (IU/L)	3.00	0.00 - 22.30
CH, BUN	70	6-30
CH, Creatinine	3.82	0.6-1.6

LIVER

KIDNEY

What is going on with Otis?

Kidney and Liver Disease

Concern for failure of both organs

What are some causes? Toxins and infections

Toxins: no known toxins

Infectious agents: leptospirosis, other bacterial infections, and potentially some viruses

Leptospirosis

Spirochete bacteria (*Leptospira* spp)

Pathogenic and non-pathogenic species exist

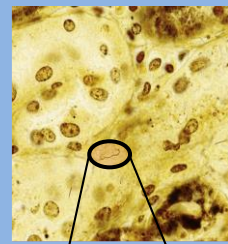
Many mammals can be infected

Disease in dogs can from 2 different Lepto spp

Pathogenic strains only replicate in a host

Readily inactivated high heat, UV light, most disinfectants, and freezing temps

When conditions are optimal, lepto can survive in wet soil & water for weeks to months.



Exposure to our dogs



AT RISK:

Dogs that drink from, swim, or wade in outside waters

Exposure to wildlife, farm animals, or their urine

That said, dogs in urban areas are at risk, too
High rainfall, temperate climates

Variants and their hosts

Selected Serovars of *Leptospira interrogans* and *Leptospira kirschneri* that Infect Dogs*

Species	Serogroup	Serovar	Potential Reservoir Hosts	Country
<i>Leptospira interrogans</i>	Icterohaemorrhagiae	Icterohaemorrhagiae	Rats	United States, France
	Canicola	Canicola	Dogs	India, United States
	Pomona	Pomona	Horses, cattle, sea lions	United States
	Australis	Bratislava	Pigs, hedgehogs, horses	United States
	Sejroe	ND	Mice	Germany
	Ballum	Ballum	Mice, gray squirrels, muskrats, opossums	United States
<i>Leptospira kirschneri</i>	Grippityphosa	Grippityphosa	Raccoons, fox squirrels, muskrats, bobcats, voles, mice, rats, cattle, horses	United States

Natural Reservoirs



How does exposure lead to infection?

Exposure to infected urine (direct or indirect)

Bacteria invade mucous membranes of the body (oral cavity/gums, genitalia, rectum)

Multiply rapidly once they hit the bloodstream
then infects multiple organs (kidney & liver)

Ingestion of infected tissues or being bit by carrier

After exposure

Incubation period days to a couple of weeks

Mild vs Severe Infection

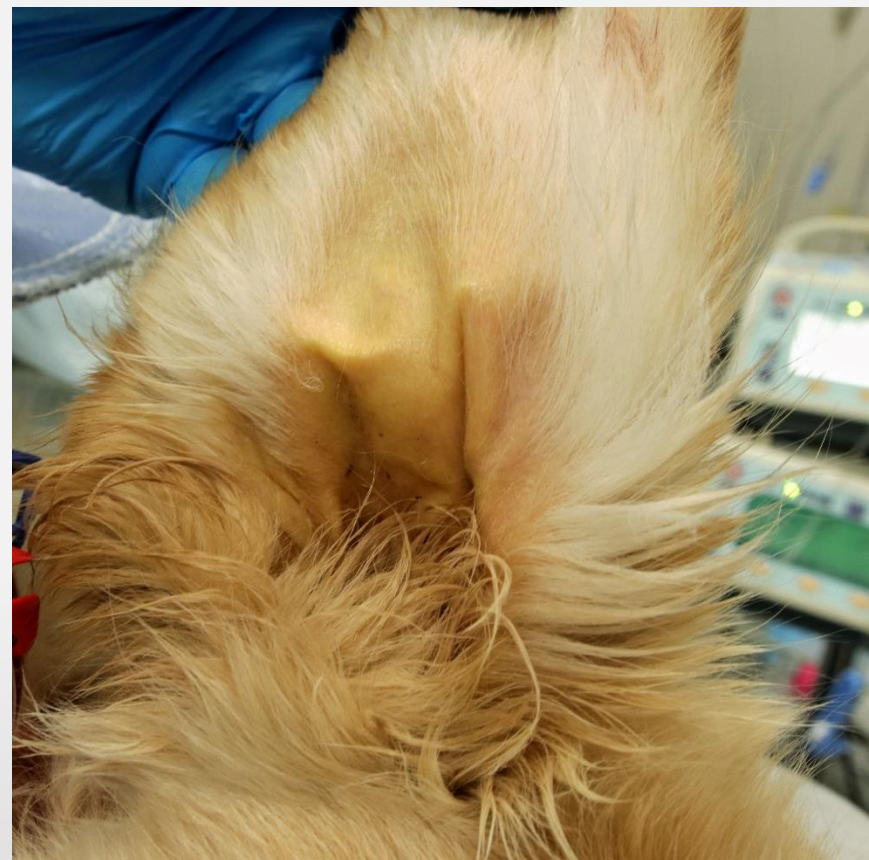
Early in the course of the disease: fever, lethargy, inappetance, vomiting and diarrhea can be seen. Excessive thirst and urinations may develop if there is kidney damage.

These signs are broad and somewhat vague.

Icterus/Jaundice



Icterus/Jaundice



Sykes, 2014

Confirming Leptospirosis

Baseline diagnostics (bloodwork and urine)
helpful to narrow down possibilities

Often imaging performed
again to screen for other disorders

Classic case of acute disease – liver and kidney

In hospital rapid test (SNAP[®] test) – specialty hosp

Other testing (PCR, serum antibody) is available



Zoonotic disease

People can catch this disease from the same places our dogs can catch it...or from a dog affected with the disease

Urine transmission

Treatment and Prognosis

Early treatment is **ESSENTIAL** for severely affected dogs

- Hospitalization with fluid therapy
- Antibiotics (several effective drugs)
- Nutritional support

Recovery in 80% of patients

What about Otis??



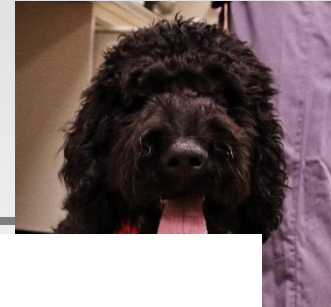
Admitted into our Intensive Care Unit

- Intravenous Fluids
- Intravenous Antibiotics
- Intravenous Anti-nausea meds
- Medications to reduce the risk of stomach ulcers

Additional testing to determine what was going on

Additional Testing – Ultrasound





Additional Testing – Lepto titer

FINAL REPORT

Medical History: Medical History on File
Animal ID: Otis, Canine :: Mixed Breed Dog / Male / 5 mo
Specimen: Blood **Collection Date:**

SEROLOGY

Test: MI. Witness Lepto IgM Screening

Animals::Specimens	Collection Date	Leptospirosis Result
Otis, 606511 :: Blood		Positive

Authorized by: Joany Van Balen Rubio

Notice: Ohio State University Veterinary Diagnostic Laboratory has transitioned to the CoreOne laboratory information management system (LIMS). With this transition, OSUVDL has updated our report design.

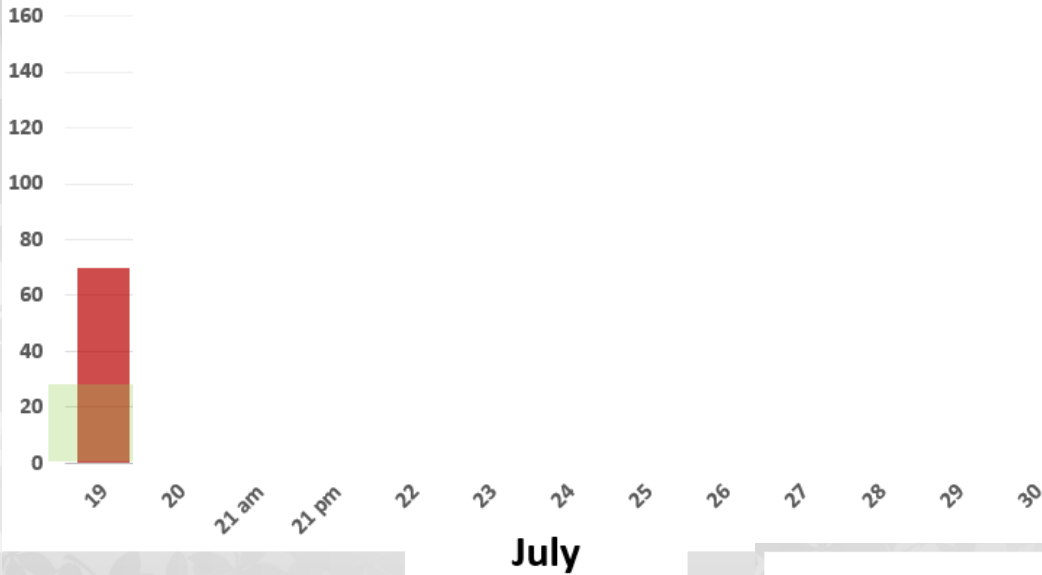


Urine production – very low; urinary catheter placed

Within 36 hours – kidneys stopped producing urine

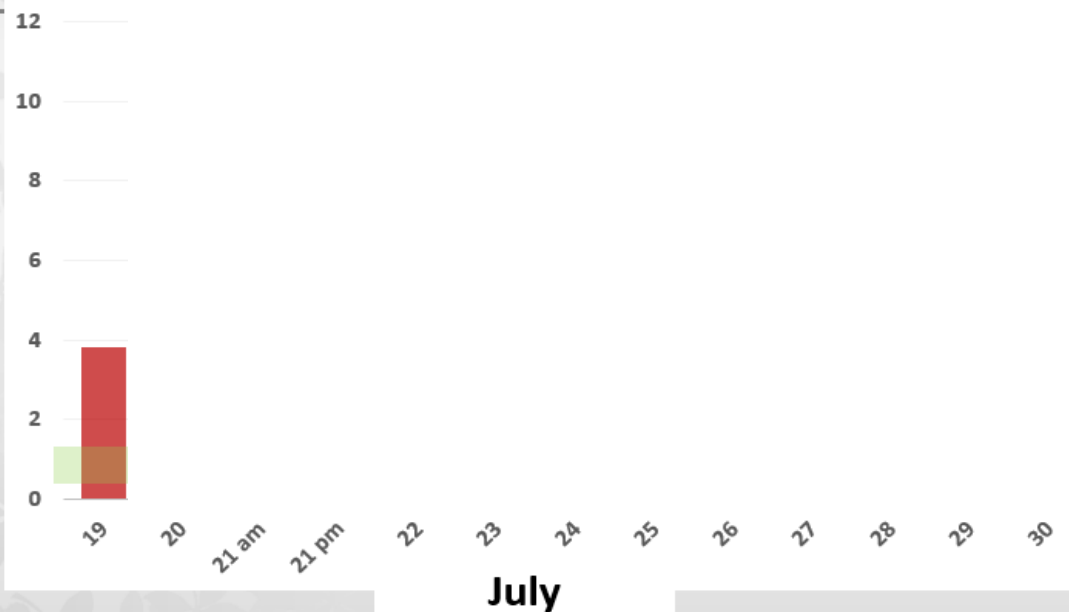


BUN - KIDNEY



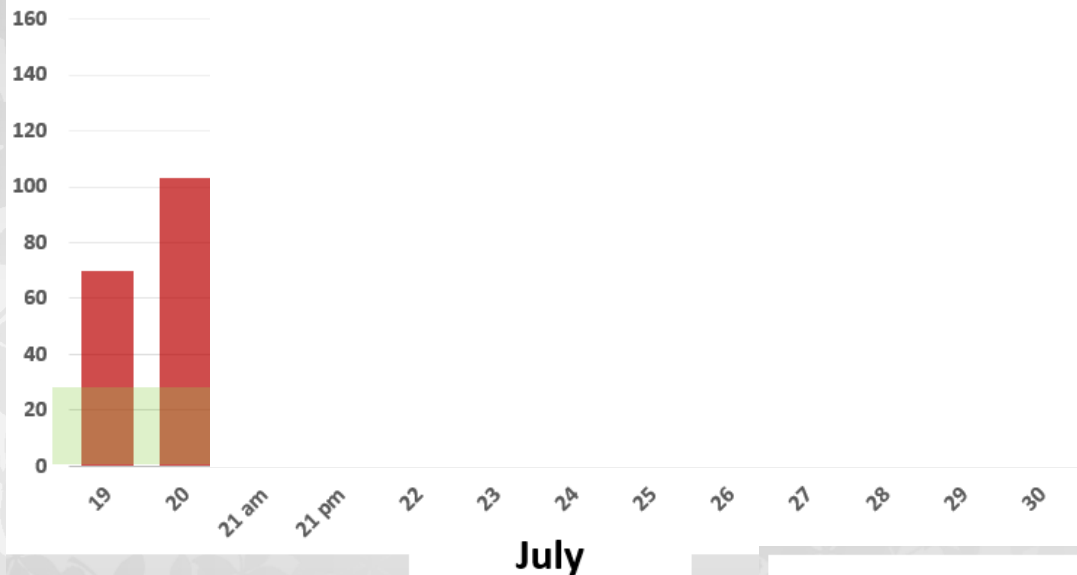
Day 1

Creatinine - KIDNEY



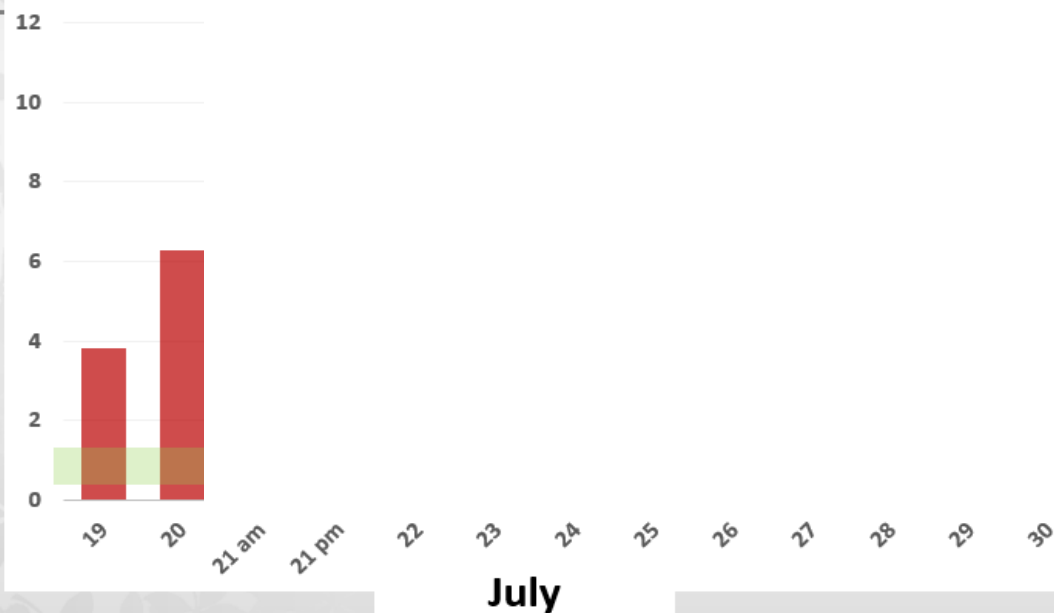


BUN - KIDNEY



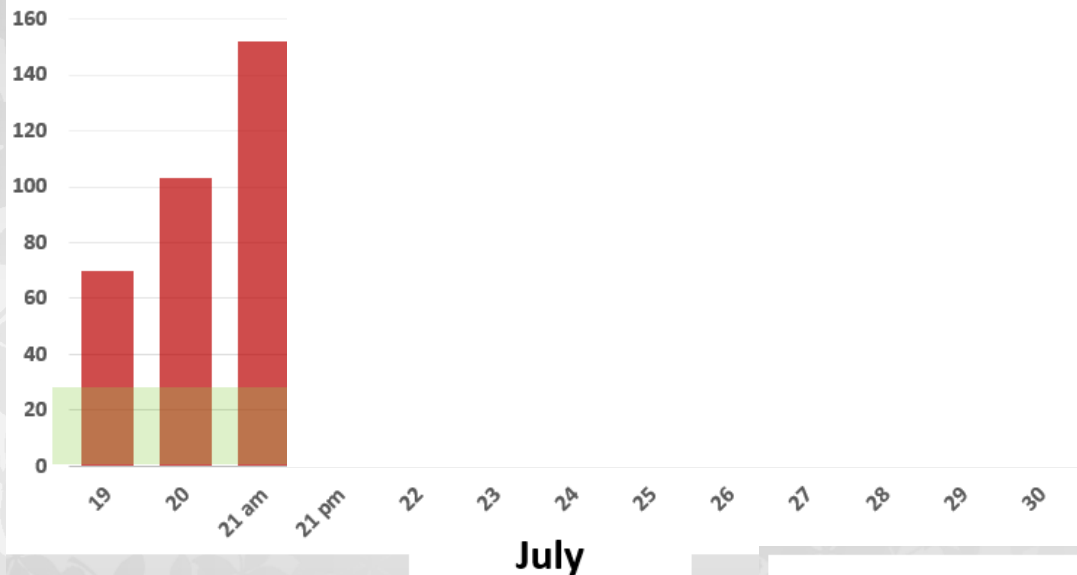
Day 2

Creatinine - KIDNEY



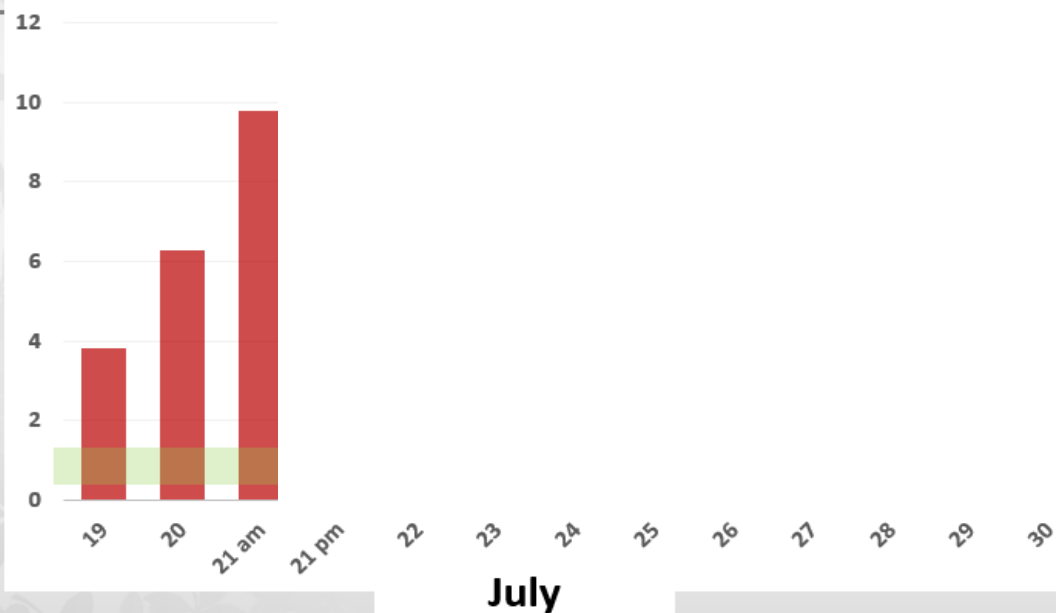


BUN - KIDNEY



**Day 3
morning**

Creatinine - KIDNEY

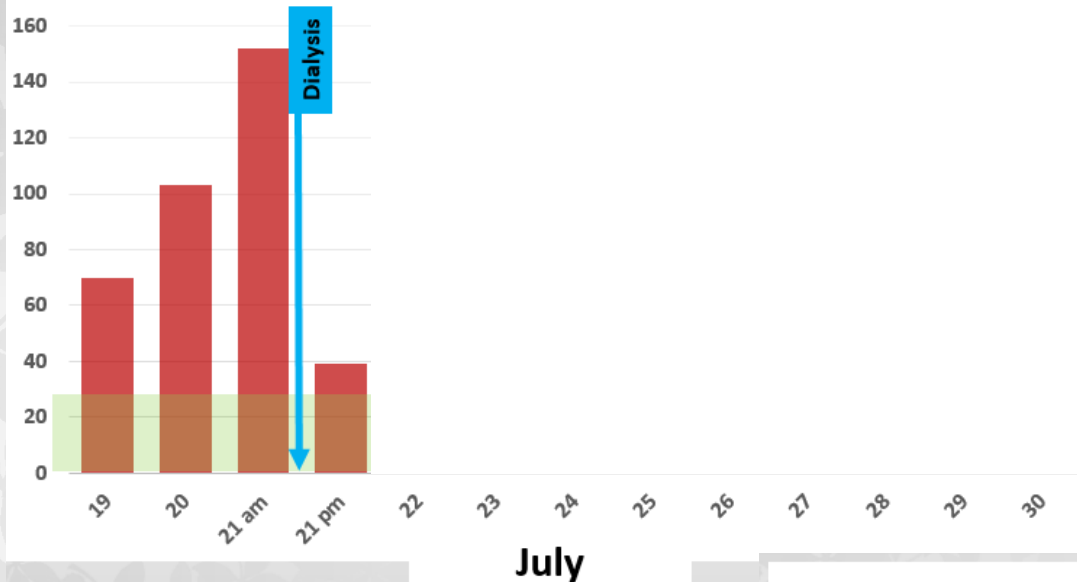


Hemodialysis



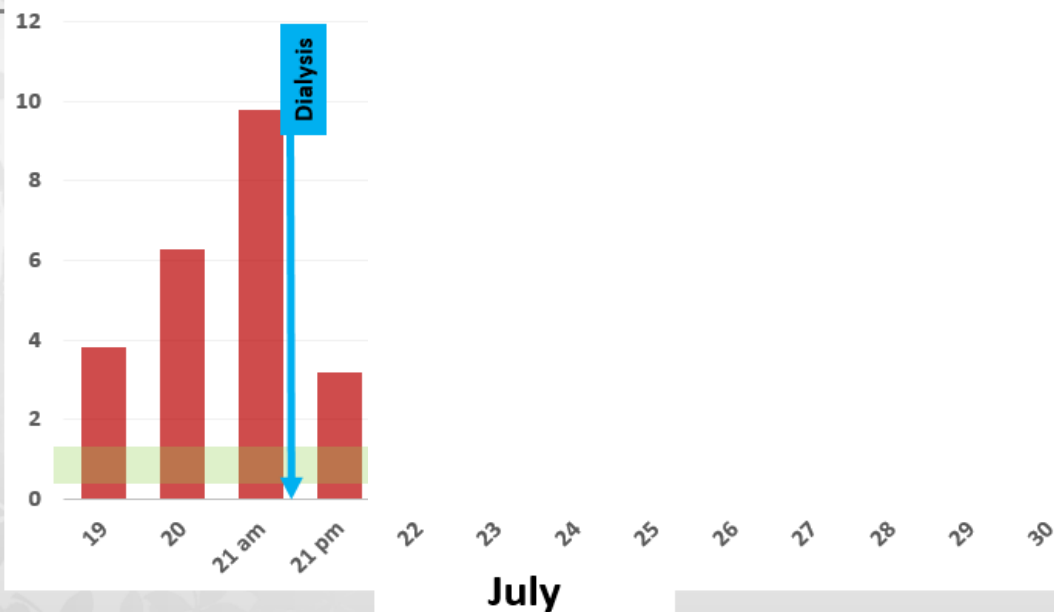


BUN - KIDNEY



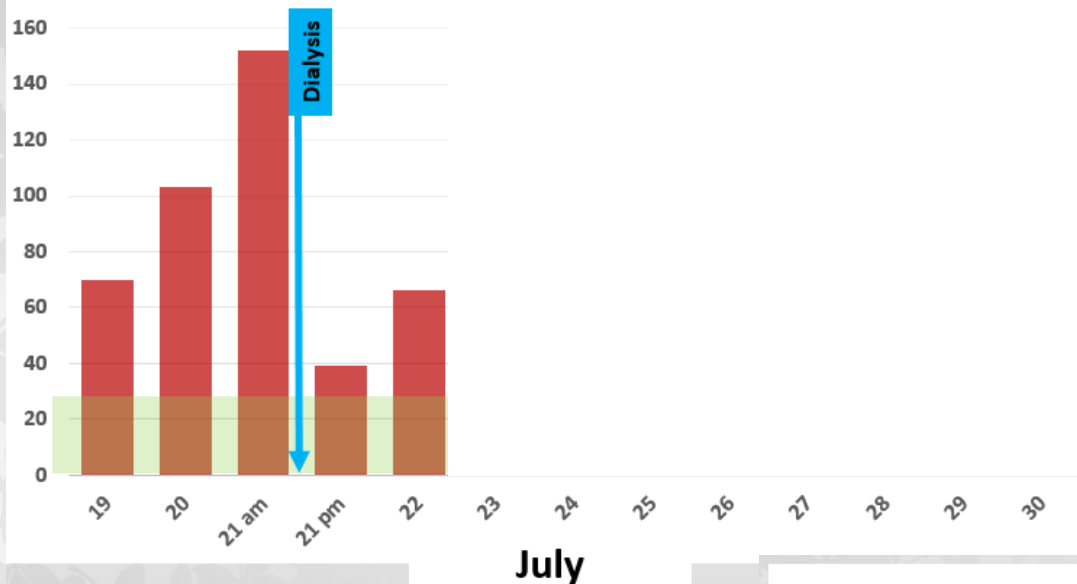
Day 3
afternoon

Creatinine - KIDNEY



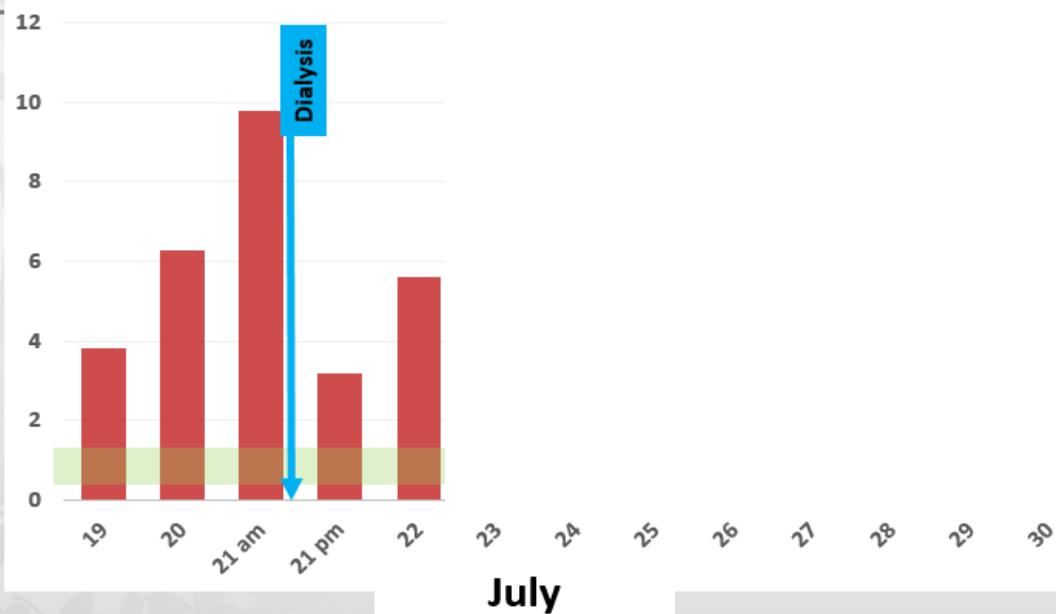


BUN - KIDNEY



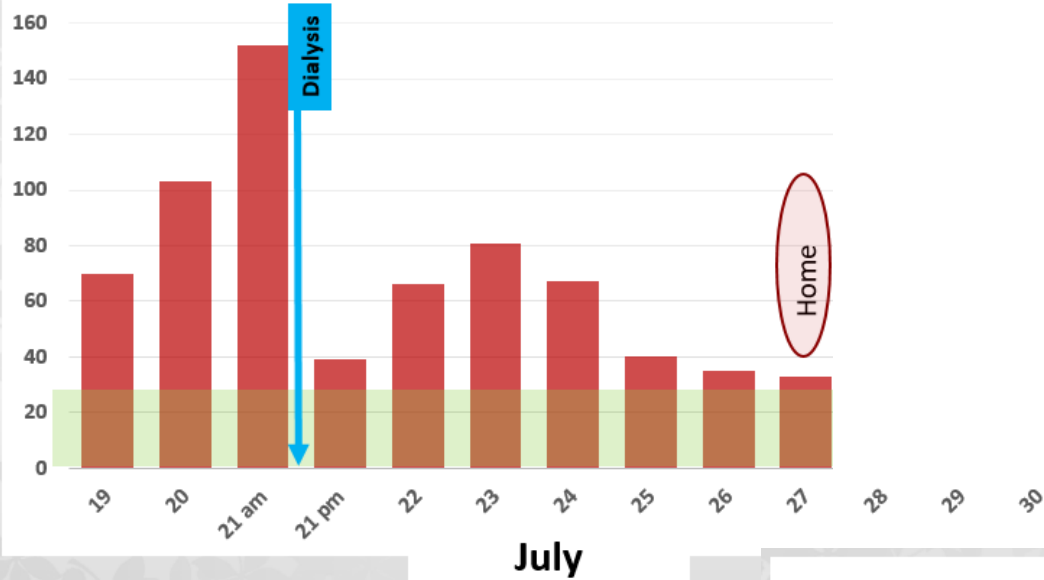
Day 4

Creatinine - KIDNEY



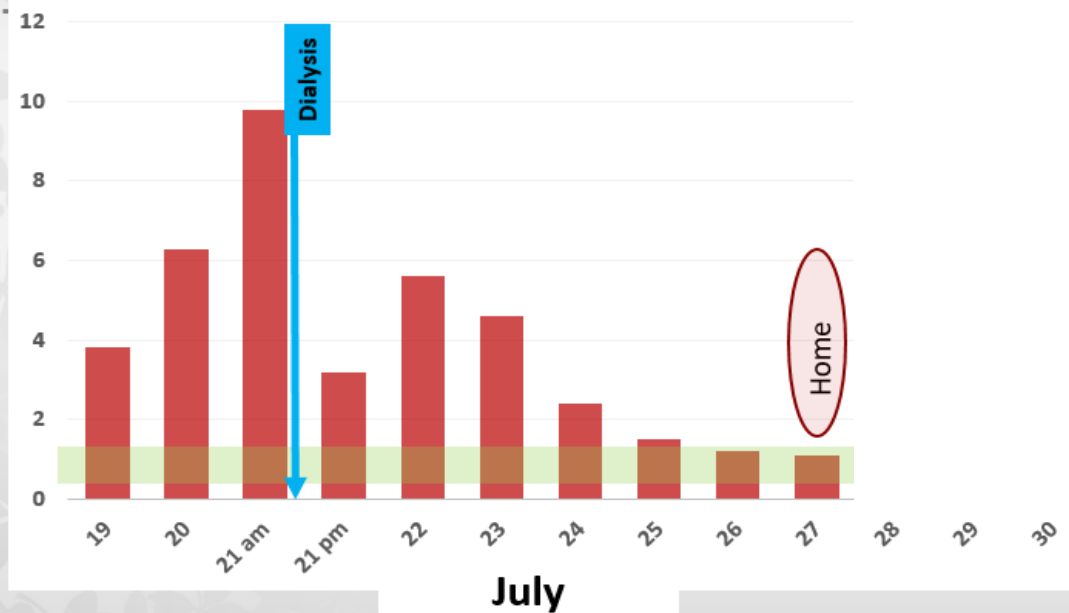


BUN - KIDNEY



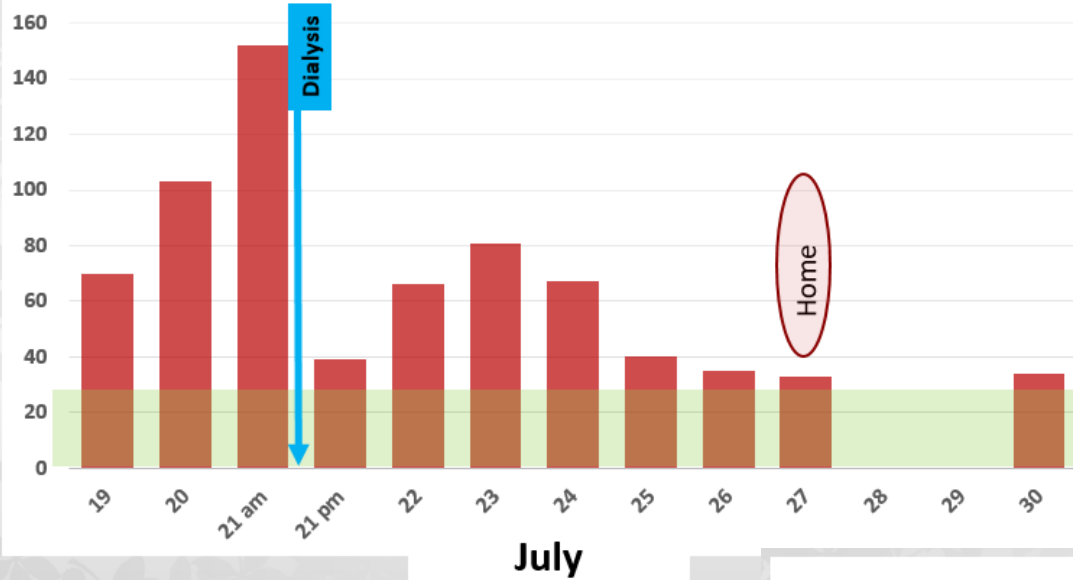
Day 5-8

Creatinine - KIDNEY



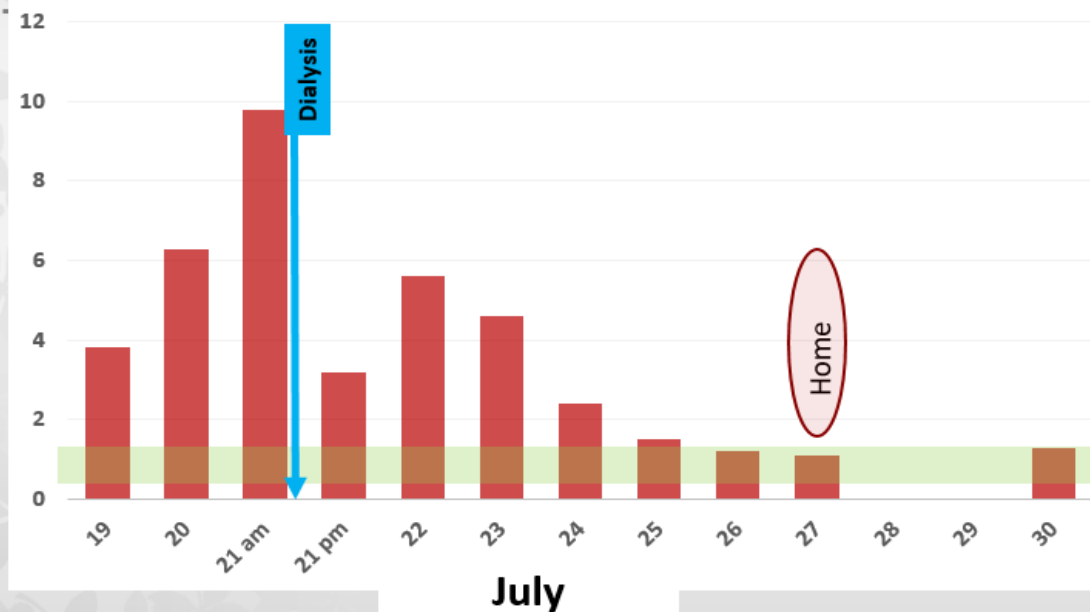


BUN - KIDNEY

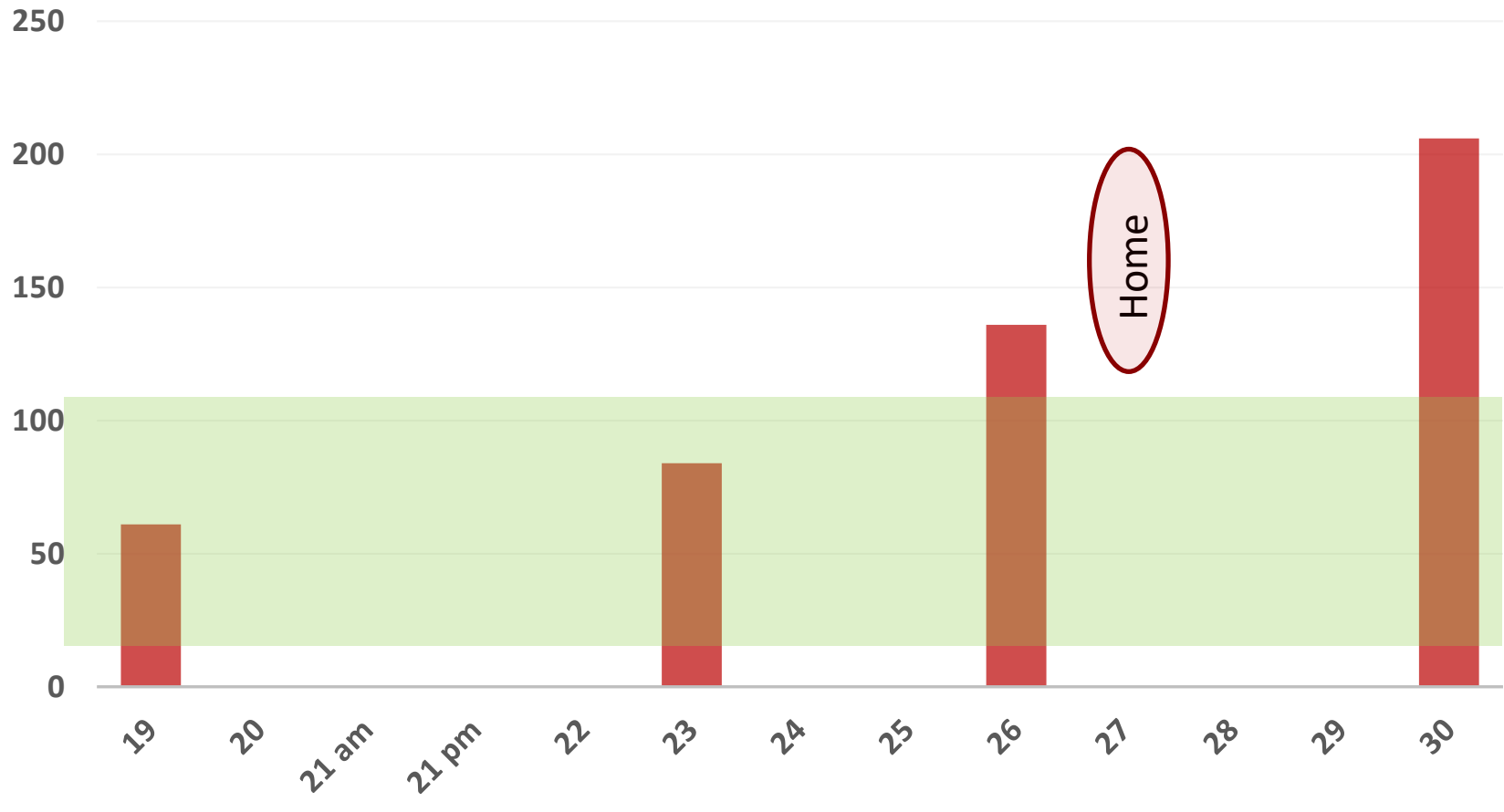


Day 11

Creatinine - KIDNEY

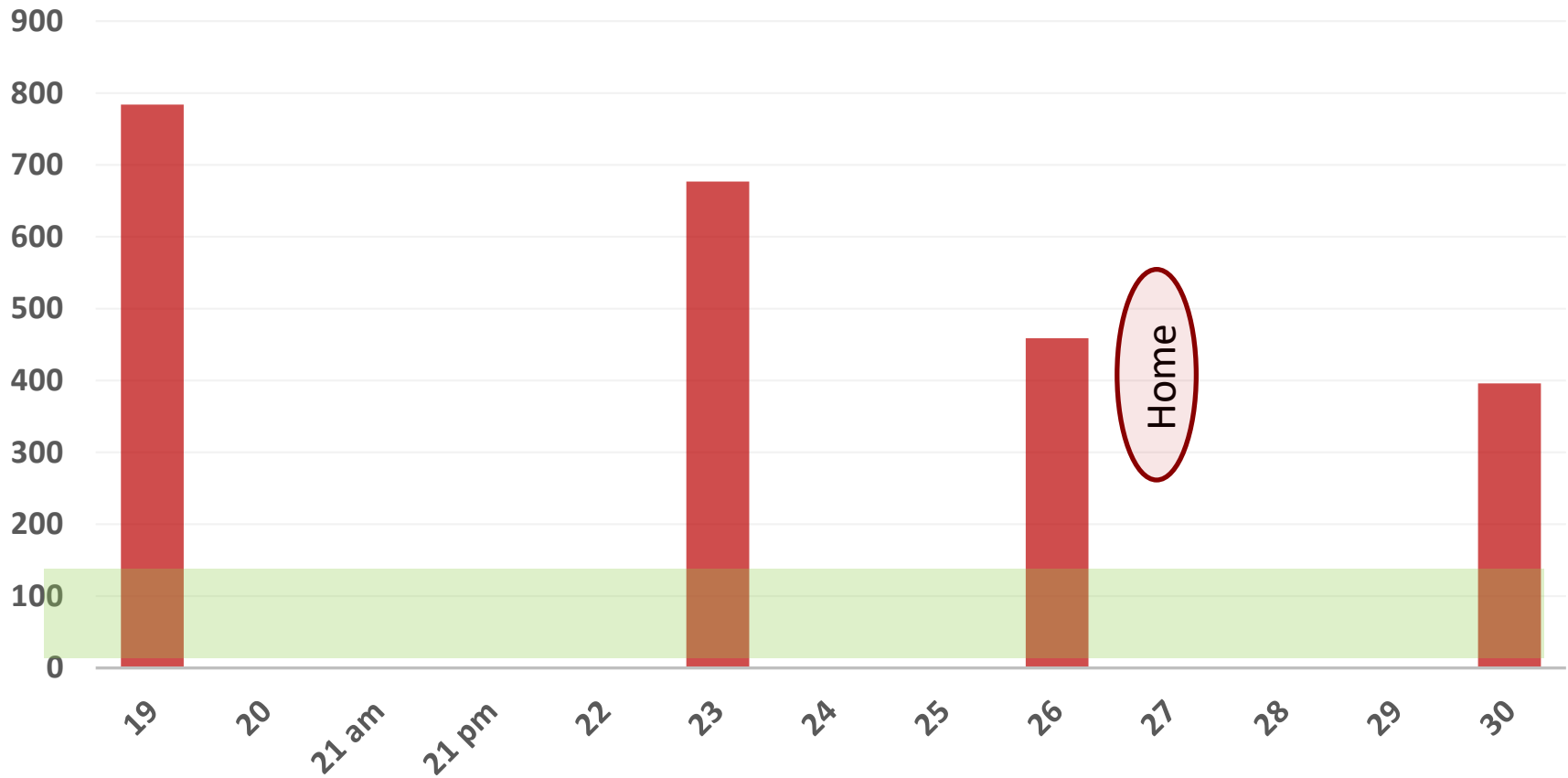


ALT - LIVER



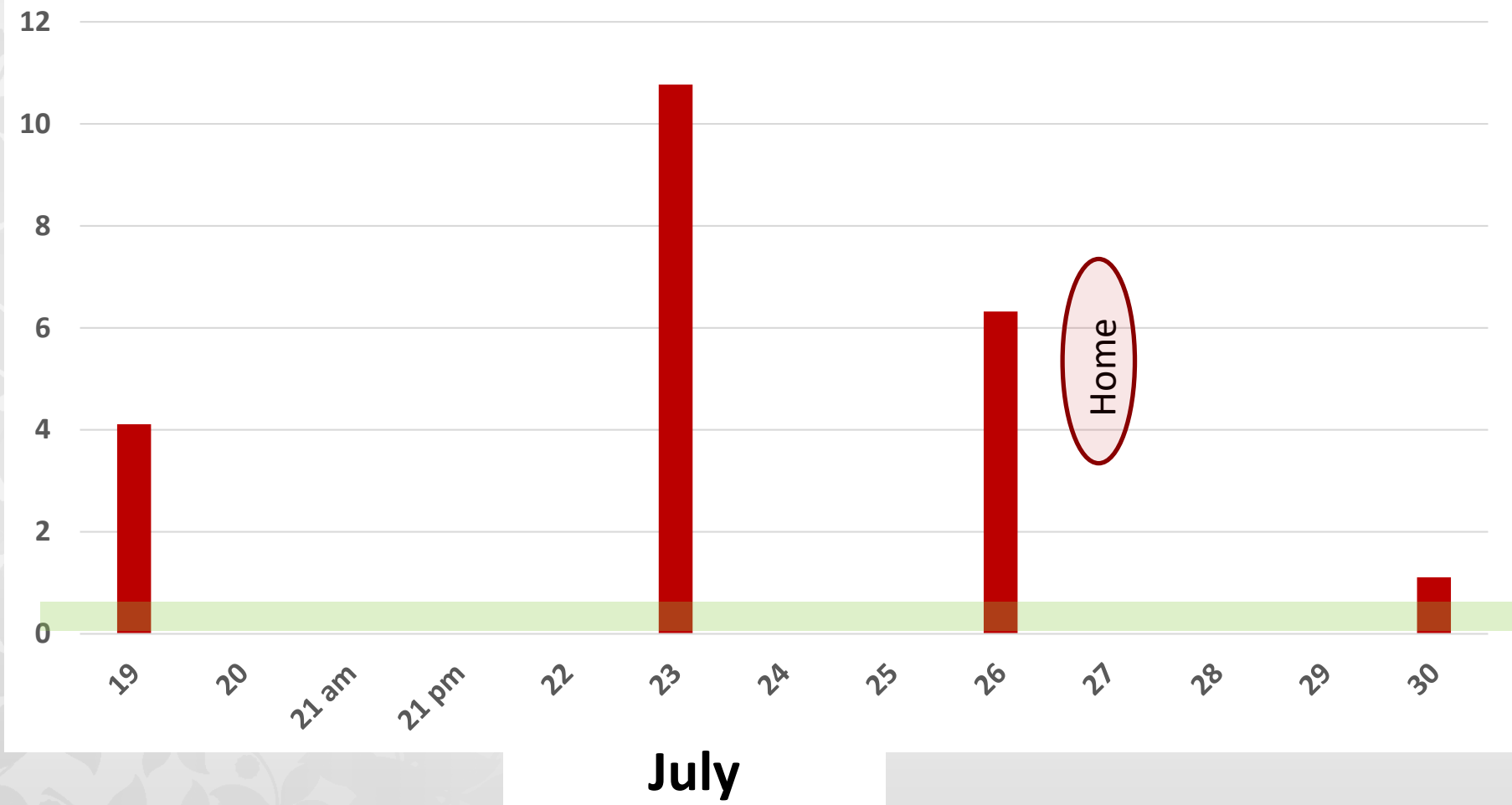
July

ALP - LIVER



July

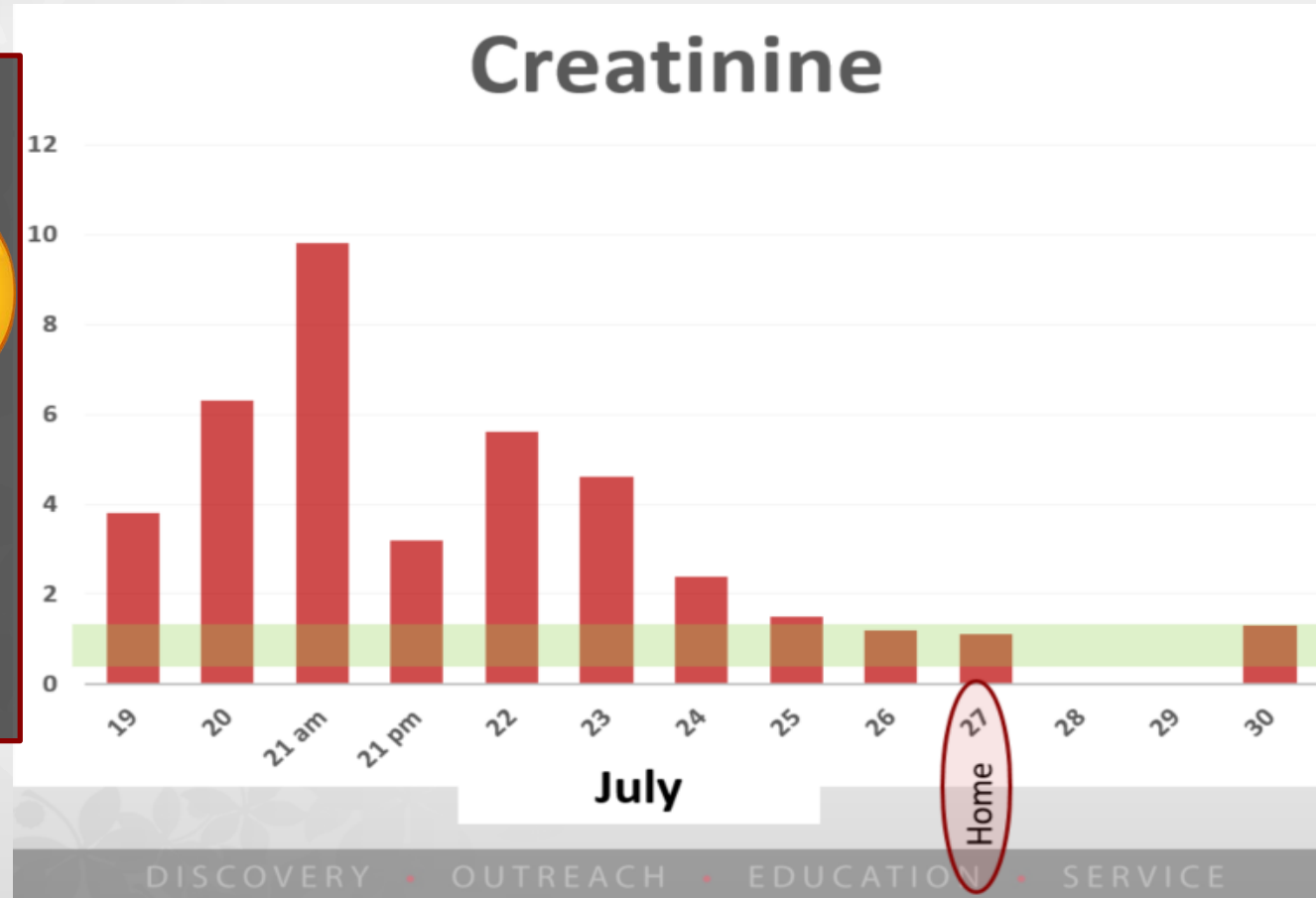
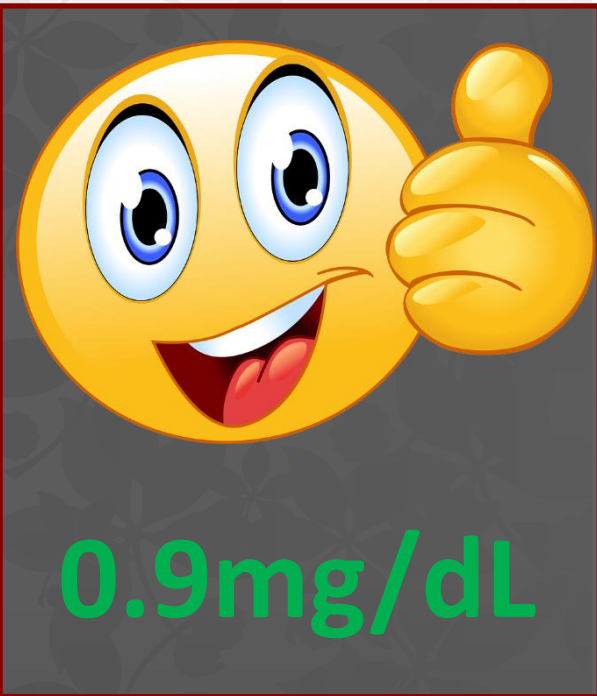
Bilirubin - LIVER



Last Friday



Aug 6th – 18 days after admission



The remainder of Otis's labs normalized as well!

Cost for Otis's Care at Ohio State University

\$8700

Insurance for your pet

Is Otis's case typical?

Classic leptospirosis leads to renal failure and liver disease.

If treatment is initiated early, recovery in 80%

Prevention

Avoid waters or other areas exposed rodents

Vaccination

Vaccination – AAHA recommendations

Leptospira (killed) 4-serovar

serovar *canicola*;
serovar
icterohaemorrhagiae;
serovar *grippityphosa*;
serovar *pomona*

Administer by the
SQ route.

Two initial doses, 2 to 4
wk apart., are required;
the initial dose may be
administered as early as
8 to 9 wk of age.

Two initial doses, 2 to 4
wk apart, are required
regardless of the
dog's age.

Where risk of exposure
is sustained, administer
a single dose 1 yr following
completion of the initial
2-dose series, then
annually thereafter.

Because there is limited
cross-protection among serovars
in the vaccine, administration of
a 4-serovar leptospirosis vaccine
is recommended over a 2-serovar
vaccine.

4-serovar leptospirosis vaccines are
available in combination with CORE
vaccines and as a 4-serovar (only)
product that is not combined with
other vaccines.

For recommendations on managing
dogs who are overdue for this vaccine,
visit aaha.org/CanineVaccinesOverdue



Lifestyle-based Vaccine Calculator

<https://www.aaha.org/aaha-guidelines/vaccination-canine-configuration/lifestyle-based-vaccine-calculator/>



Otis's lifestyle

Leash walked, with time in the backyard
No dog parks or other “risky” behavior

Soooo...what should we take away?

All dogs are at risk.

The vaccine is safe and effective

Consider having your dogs vaccinated

What about other species?

again, rarely reported in cats



Zoonosis

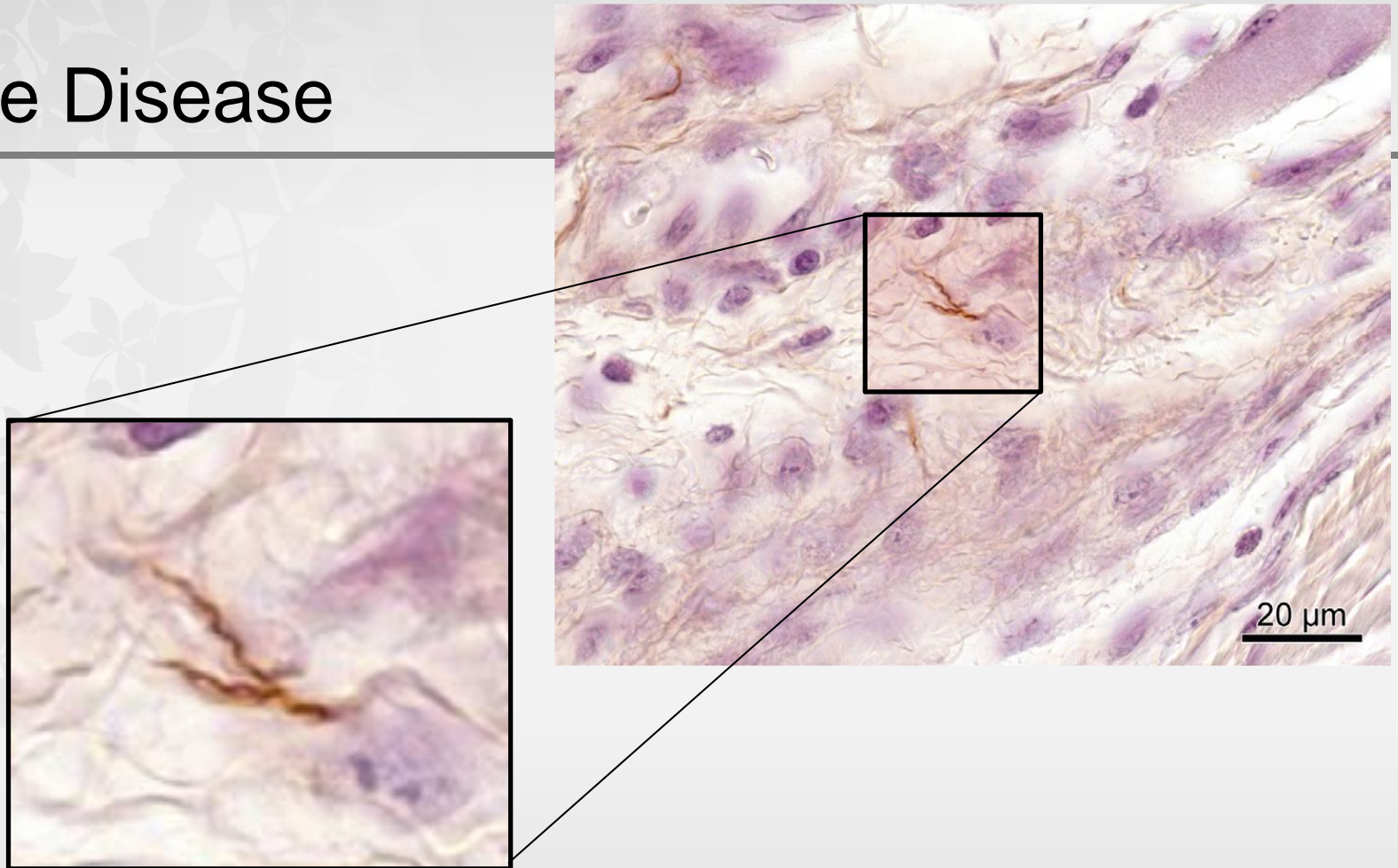
Leptospirosis CAN affect humans.

How do we get it:

- same exposure as our dogs
- from an infected dog



Lyme Disease



Sykes 2014

Borrelia burgdorferi

Pathogenic and Nonpathogenic Species That Belong to *Borrelia burgdorferi* sensu lato and Their Geographic Distributions

	United States	Europe	Asia
Pathogenic	<i>B. burgdorferi</i> sensu stricto	<i>B. burgdorferi</i> sensu stricto <i>B. afzelii</i> <i>B. garinii</i>	<i>B. afzelii</i> <i>B. garinii</i>
Non-pathogenic or question- able patho- genicity	<i>B. bissettii</i> <i>B. andersonii</i> <i>B. californiensis</i> <i>B. carolinensis</i> <i>B. americana</i> <i>B. kurtenbachii</i>	<i>B. valaisiana</i> * <i>B. bissettii</i> * <i>B. spielmanii</i> * <i>B. lusitaniae</i> <i>B. bavariensis</i>	<i>B. bissettii</i> * <i>B. japonica</i> <i>B. turdi</i> <i>B. tanukii</i> <i>B. sinica</i> <i>B. yangtze</i>

**B. valaisiana* and *B. bissettii* have been isolated from single cases of Lyme borreliosis; *B. spielmanii* has been detected in early skin lesions (Stanek G, Reiter M. The expanding Lyme *Borrelia* complex—clinical significance of genomic species? Clin Microbiol Infect 2011;17:487-493).

Sykes 2014



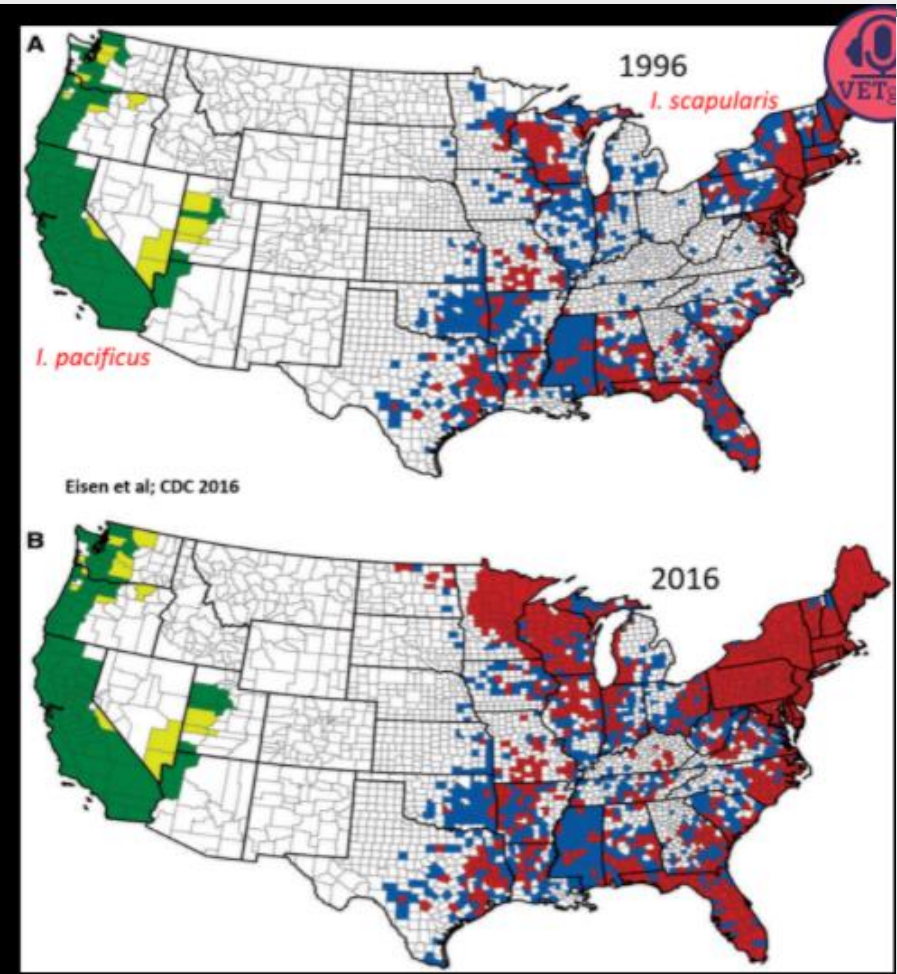
FIGURE 51-1 Approximate geographic distribution of Lyme borreliosis in humans (and dogs) in the United States.

Sykes 2014

Changes in tick populations

The Expanding Tick Population

- Positive antibody tests in 2020 in dogs
 - Lyme – 471,000
 - Ehrlichiosis – 244,675
 - Anaplasma – 247,105





Ixodes tick transmit Borrelia worldwide



Vectors of Lyme Disease Worldwide			
Geographic Location	Tick Species	Common Name	Reservoir host for <i>Borrelia</i>
Western United States	<i>Ixodes pacificus</i>	Pacific black-legged tick	Western gray squirrel
Northeastern and upper Midwestern United States	<i>Ixodes scapularis</i>	Black-legged tick	White-footed mouse, shrews, chipmunks
Europe	<i>Ixodes ricinus</i>	Castor bean or sheep tick	Squirrels, thrushes, chipmunks, mice, shrews, hedgehogs, rats, hares, pheasants, voles
Asia	<i>Ixodes persulcatus</i>	Taiga tick	Voles

Sykes 2014

Apple W 60208



Reservoir hosts

Rodents

white footed mouse

chipmunk

shrew

grey squirrels

birds

coyotes

Deer



These animals carry the disease, but do not become ill

Transmission

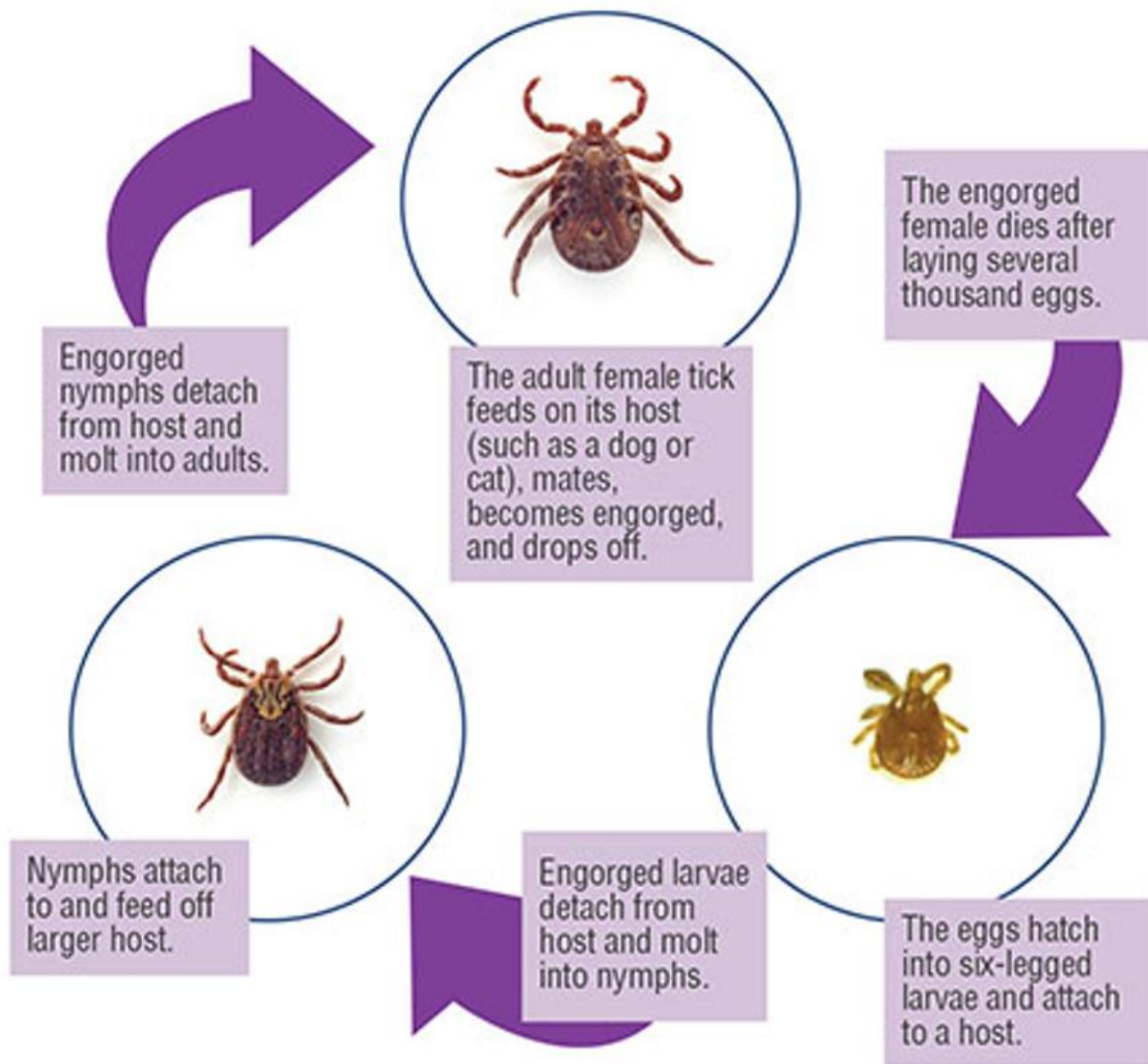
Thought that the tick must attach \geq 24-36 hrs

Few human cases reported shorter transmission time

The bacteria replicates at the site of the bite, then disseminates through bloodstream

The organism typically targets the connective tissue

The Lifecycle of the Tick



Clinical Signs

Estimated that ~10% of dogs exposed will develop signs (humans – 90% develop disease)

Initial signs develop 2-5 months after the tick bite

Signs: fever, inappetance, and lameness/swollen joints – common

Primary problems reported with the disease

- inflammatory joint disease

- kidney disease

- potentially cardiac disease

Diagnosis

Challenging as many patients test positive as a result of exposure (but not active disease).

The veterinarian has to put a positive test result in the context of your dog's illness

Screening bloodwork and urine evaluation:

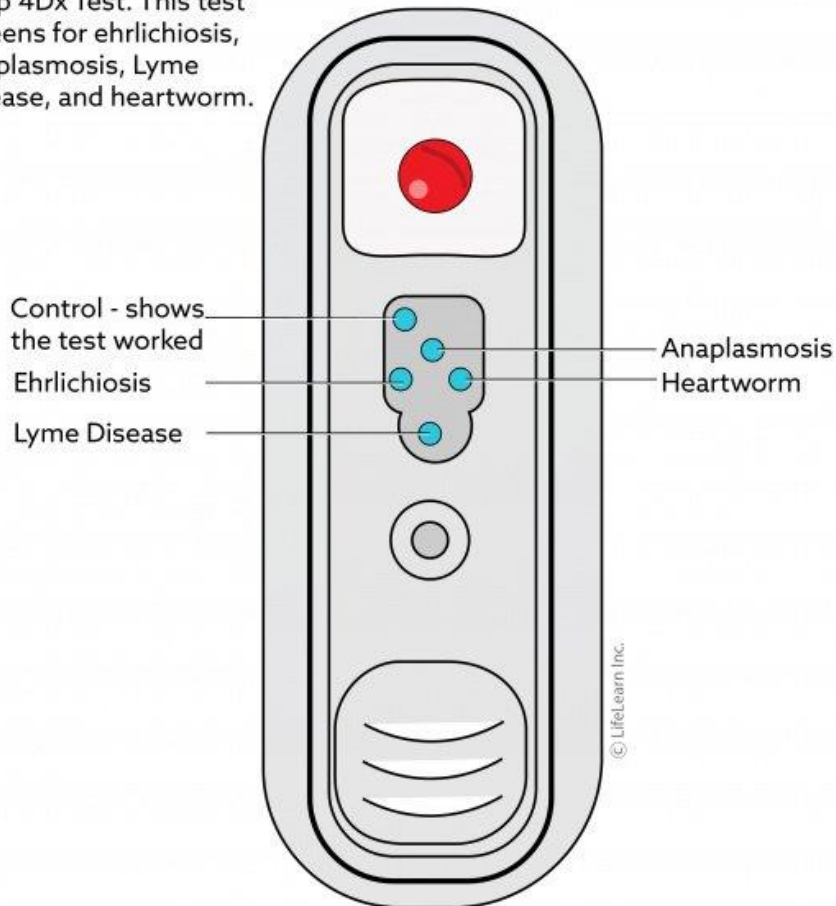
- Lyme arthritis – non-specific changes

- Lyme related kidney disease – kidney failure

X-rays reveal excess fluid in the joint(s)

4Dx SNAP test – in hospital

Snap 4Dx Test. This test screens for ehrlichiosis, anaplasmosis, Lyme disease, and heartworm.



Heartworm	<i>E. canis</i>	Lyme	<i>A. phagocytophilum</i>
Sensitivity: 99%	Sensitivity: 99%	Sensitivity: 99%	Sensitivity: 99%
Specificity: 100%	Specificity: 100%	Specificity: 100%	Specificity: 100%
(95% CL 95-100%)	(95% CL 98-100%)	(95% CL 98-100%)	(95% CL 95-100%)

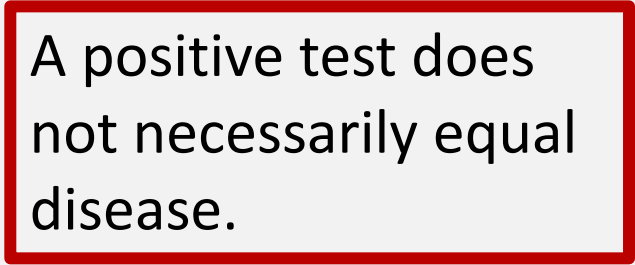
Other blood tests for Lyme Disease

C6 Assay

Traditional antibody testing

Western blot

Multiplex (OspA, OspC, OspF)



A positive test does not necessarily equal disease.

Again, a positive test must be put into context.

For my own dogs...

Acute lameness affecting multiple joints with a positive test...I would treat for Lyme disease.

No evidence in treating an asymptomatic dog who tests positive (during routine HW testing).

If test positive on yearly HW testing...check urine!

Treatment and Prognosis

Treatment of choice: doxycycline for 4 weeks

Dogs with Lyme arthritis improve in 1-3 days

if a dog does not begin to improve, there is likely another cause. Px: good?

Lyme nephritis – guarded to poor prognosis

doxycycline with immunosuppressant drugs

The titer (testing) can remain positive for a long time

Vaccination

Four vaccines available for dogs

all stimulate the dog's immune system to produce antibodies that are fatal to Lyme against proteins on the surface of the bacteria

The tick feeds and the ingested blood has antibodies that kill bacteria in the tick

Prevention

Avoidance of tick infested areas, if possible

Topical treatments to reduce ticks on your dog

Oral medications (ie, Bravecto) – side effects

Checking your dogs/tick removal

Humans

Check yourself

Vaccine – removed from market 2001.

80-90% of humans: red
“bullseye” skin rash

Call your doctor right away!



What about other tick borne diseases?

Tick-borne diseases in North America

Lyme disease



Ehrlichiosis



Anaplasmosis



If tests positive...you should consider having pet vaccinated. Won't clear existing infection, but will protect against a new infection

Possums: carry ticks

Vaccination – AAHA recommendations

Borrelia burgdorferi (canine Lyme disease)

Four vaccine types are currently available:

- killed whole cell bacterin (OspA),
- killed whole cell bacterin (OspA+C),
- recombinant OspA,
- chimeric-recombinant OspA+OspC

Administer by the SQ route.



Two initial doses, 2 to 4 wk apart, may be administered as early as 8 or 9 wk of age (as labeled); (see REMARKS).

Two initial doses, 2 to 4 wk apart, are required regardless of the dog's age (see REMARKS).

Where risk of exposure is sustained, administer a single dose 1 yr following completion of the initial 2-dose series, then annually thereafter.

Dogs traveling into Lyme-disease-endemic areas from nonendemic areas may be at increased risk for exposure and infection. Vaccination may be indicated: administer 2 doses of vaccine, 2 to 4 wk apart, such that the last dose is administered approximately 2 to 4 wk prior to travel.

For recommendations on managing dogs who are overdue for this vaccine, visit aaha.org/CanineVaccinesOverdue

Lifestyle-based Vaccine Calculator

<https://www.aaha.org/aaha-guidelines/vaccination-canine-configuration/lifestyle-based-vaccine-calculator/>



Vaccines – which ones should my dog have?

Calculator

<https://www.aaha.org/aaha-guidelines/vaccination-canine-configuration/lifestyle-based-vaccine-calculator/>

Which vaccine?

	Nobivac [®] Lyme	RECOMBITEK [®] Lyme	Duramune [®] Lyme	VANGUARD [®] crLyme
Induces borreliacidal antibodies that kill viable OspA-expressing spirochetes	✓	✓	✓	✓
Induces borreliacidal antibodies that kill viable OspC-expressing spirochetes	✓			
Shown to be effective against clinical disease caused by <i>B. burgdorferi</i>	✓	✓	✓	✓
Labeled effective against subclinical arthritis caused by <i>B. burgdorferi</i>	✓			
Initial vaccination, weeks	8	9	9	8
Second dose, weeks	2-4	2-3	2-3	3

<https://www.merck-animal-health-usa.com/nobivac/nobivac-lyme-vaccine>

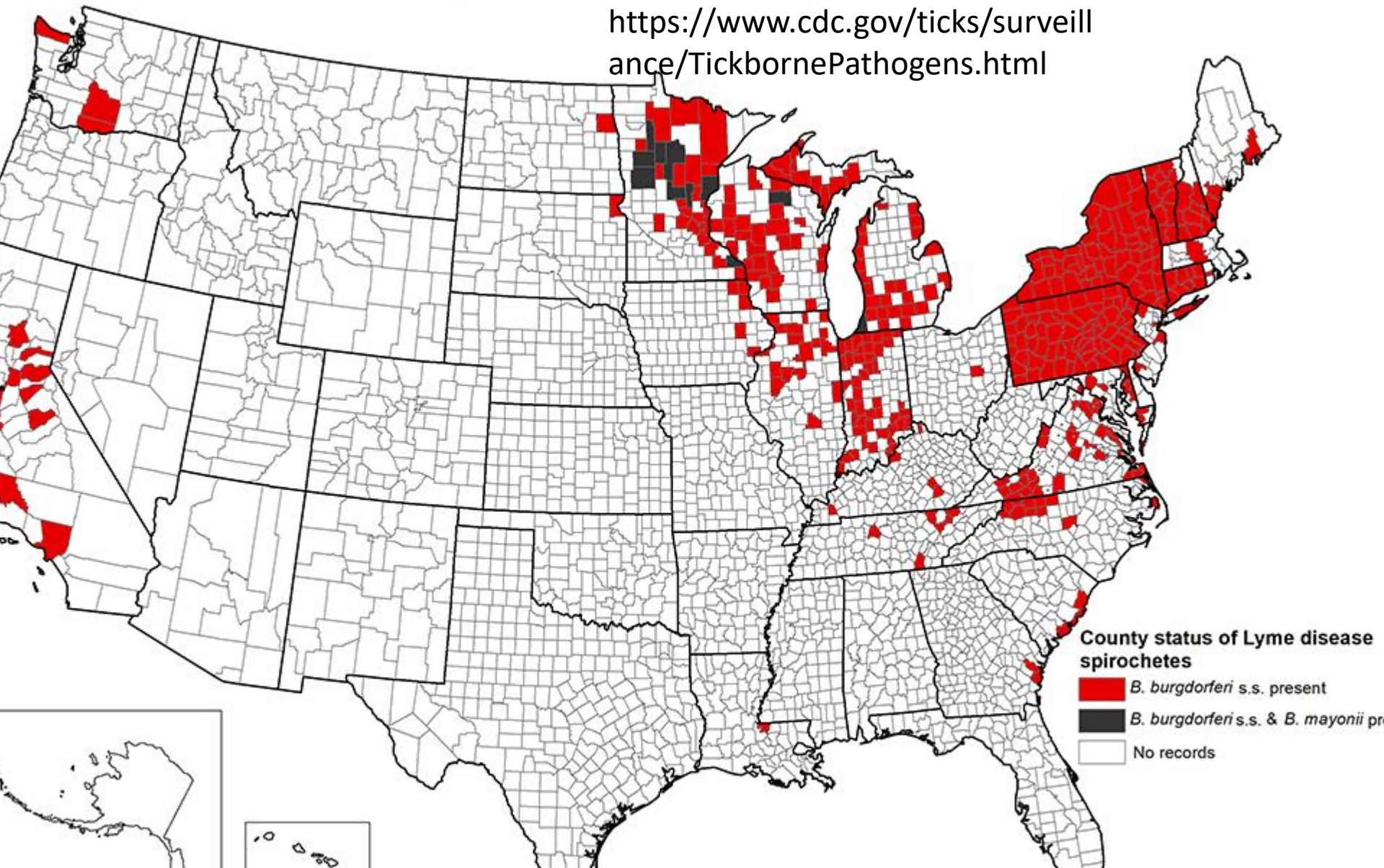
Anaplasma

Recently affected one of our own (Ganon)

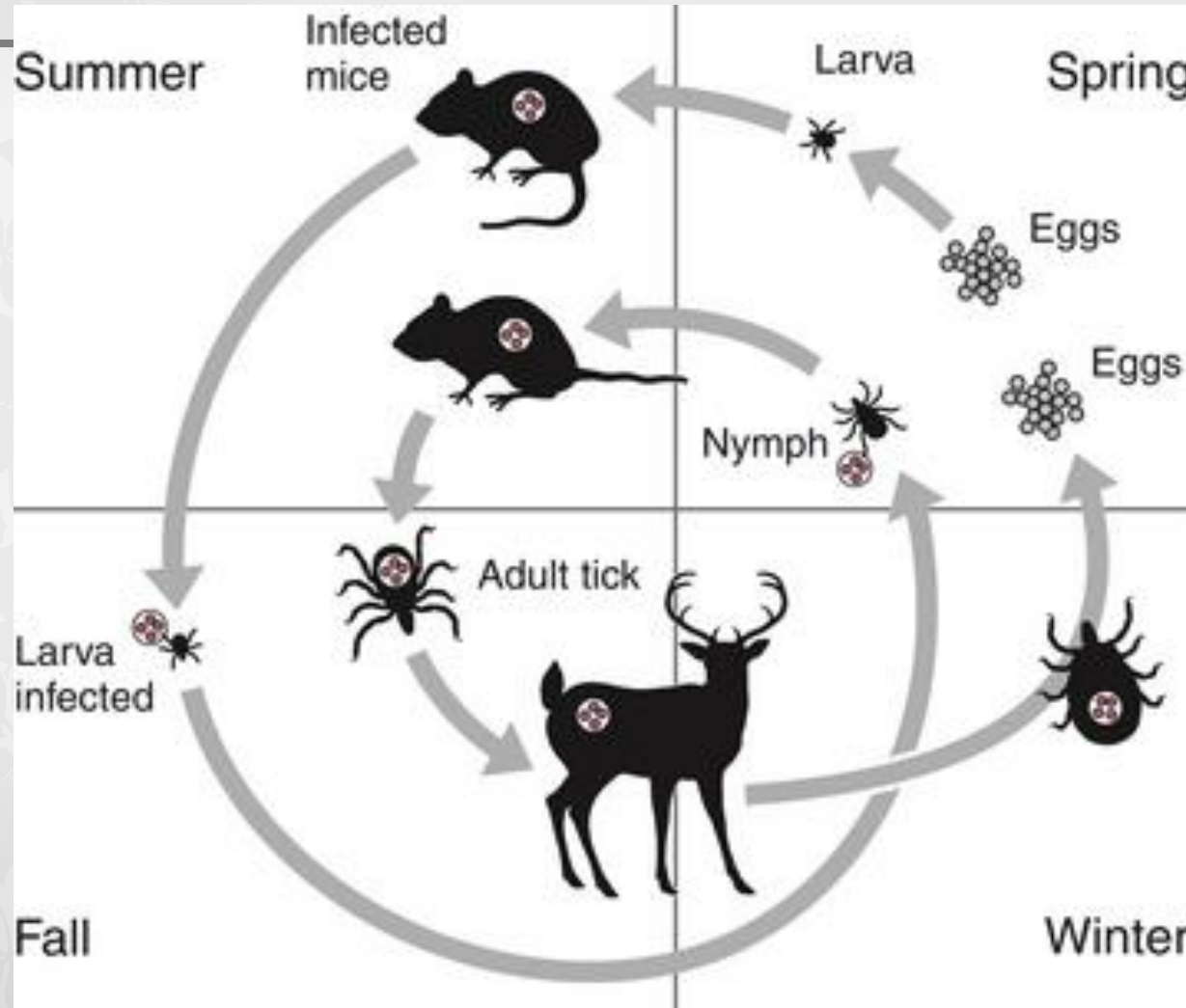
Worth mentioning here...along with the other bugs

Distribution of Lyme disease spirochetes in host-seeking *Ixodes scapularis* and *Ixodes pacificus* ticks

<https://www.cdc.gov/ticks/surveillance/TickbornePathogens.html>



Anaplasma is transmitted throughout the life of a tick...ticks must be attached for at least 36 hours



Clinical Signs

Fever, inappetance, lethargy, joint pain
rarely vomiting and/or diarrhea

Incubation period: 1-7 days

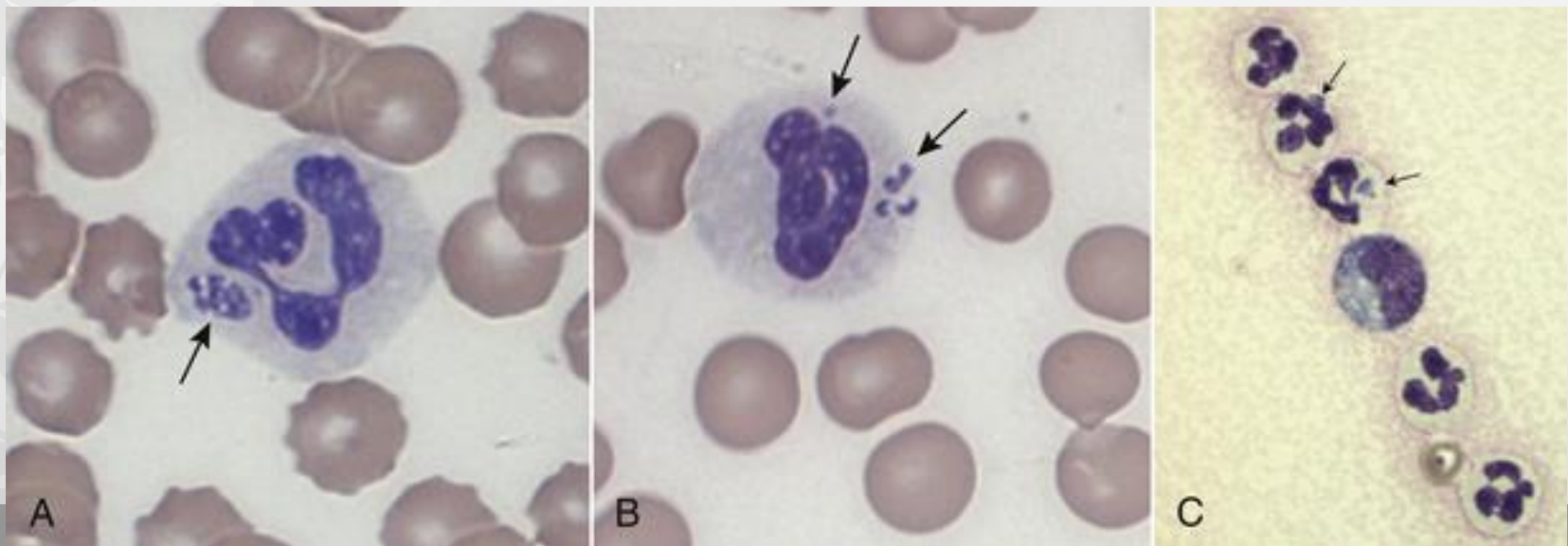
Some dogs will remain asymptomatic

Making the diagnosis

Routine testing for Heartworm Disease (in-house)

Identifying the organism on a blood smear

More specialized blood tests that your vet can send out (antibody testing or PCR testing)



Treatment and Prognosis

Doxycycline: 2-4 weeks

Improvement seen within a few days in most (~2/3)

No vaccine available, infection may result in protection from re-infection

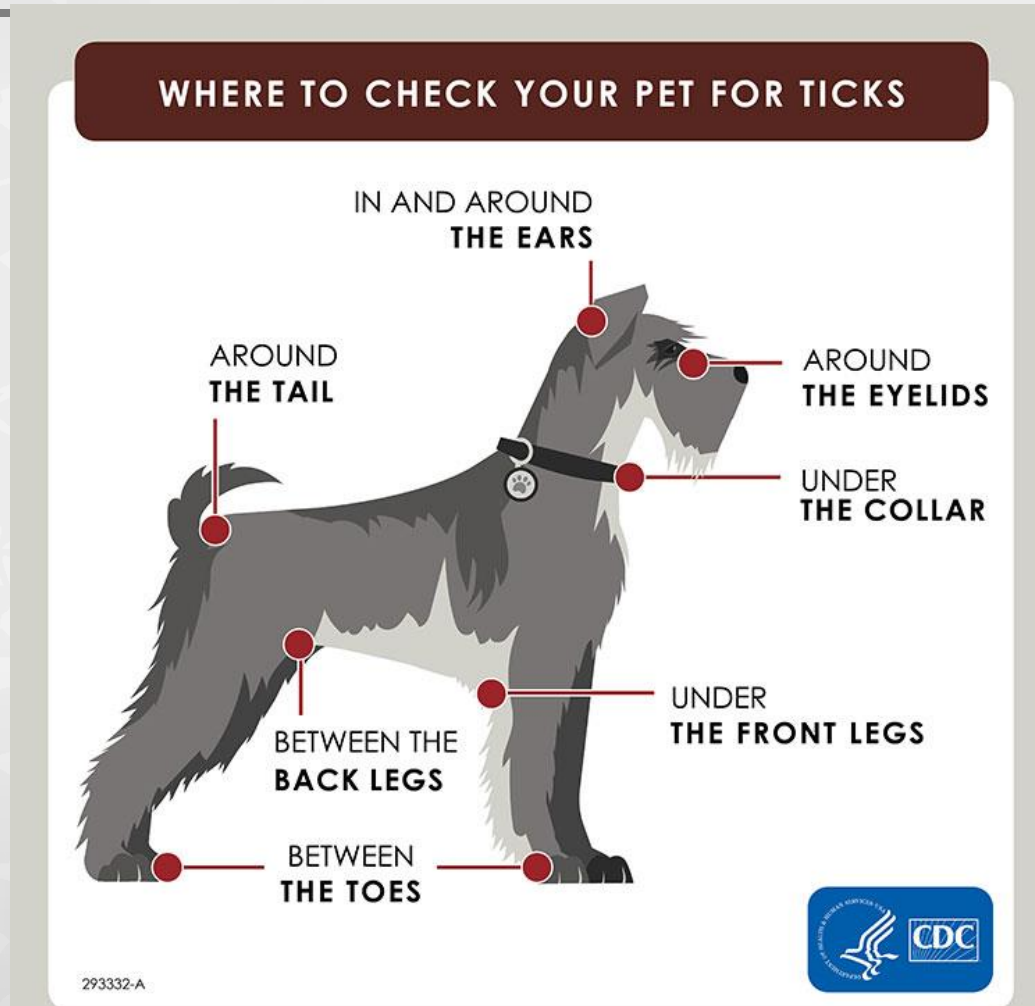
Humans: fever, muscle aches, headaches, joint pain

may resolve without therapy in people

not transmitted directly from dogs to humans

– infected person must be bitten by tick

What about ticks

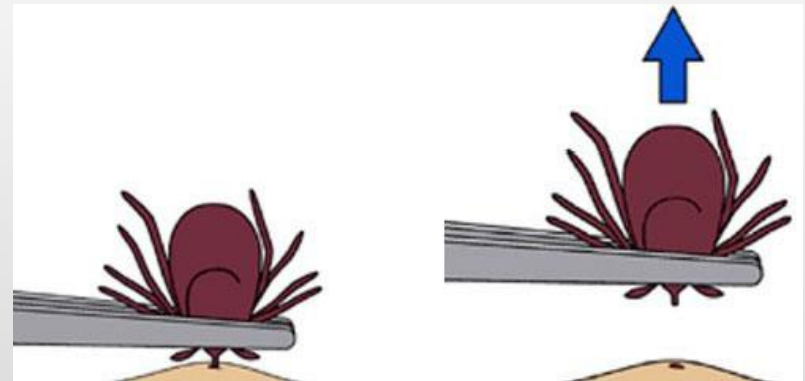


https://www.cdc.gov/lyme/prev/on_pets.html

https://www.cdc.gov/ticks/removing_a_tick.html

Never crush a tick with your fingers. Dispose of a live tick by

- Putting it in alcohol,
- Placing it in a sealed bag/container,
- Wrapping it tightly in tape, or
- Flushing it down the toilet.



Tick prevention

Isoxazoline Flea and Tick Products:

- Bravecto
- Nexgard
- Simparaca
- Credelio
- Revolution Plus

- Isoxazoline products have been associated with neurologic adverse reactions, including muscle tremors, ataxia, and seizures in some dogs and cats;
- Although most dogs and cats haven't had neurologic adverse reactions, seizures may occur in animals without a prior history;
- Many products are available for prevention and control of flea and tick infestations. You can discuss all options with your veterinarian to choose the right product for your pet.

Thank you! Questions?

