



I'll have mine with a twist of Lyme: Lyme disease in the Dairy State.

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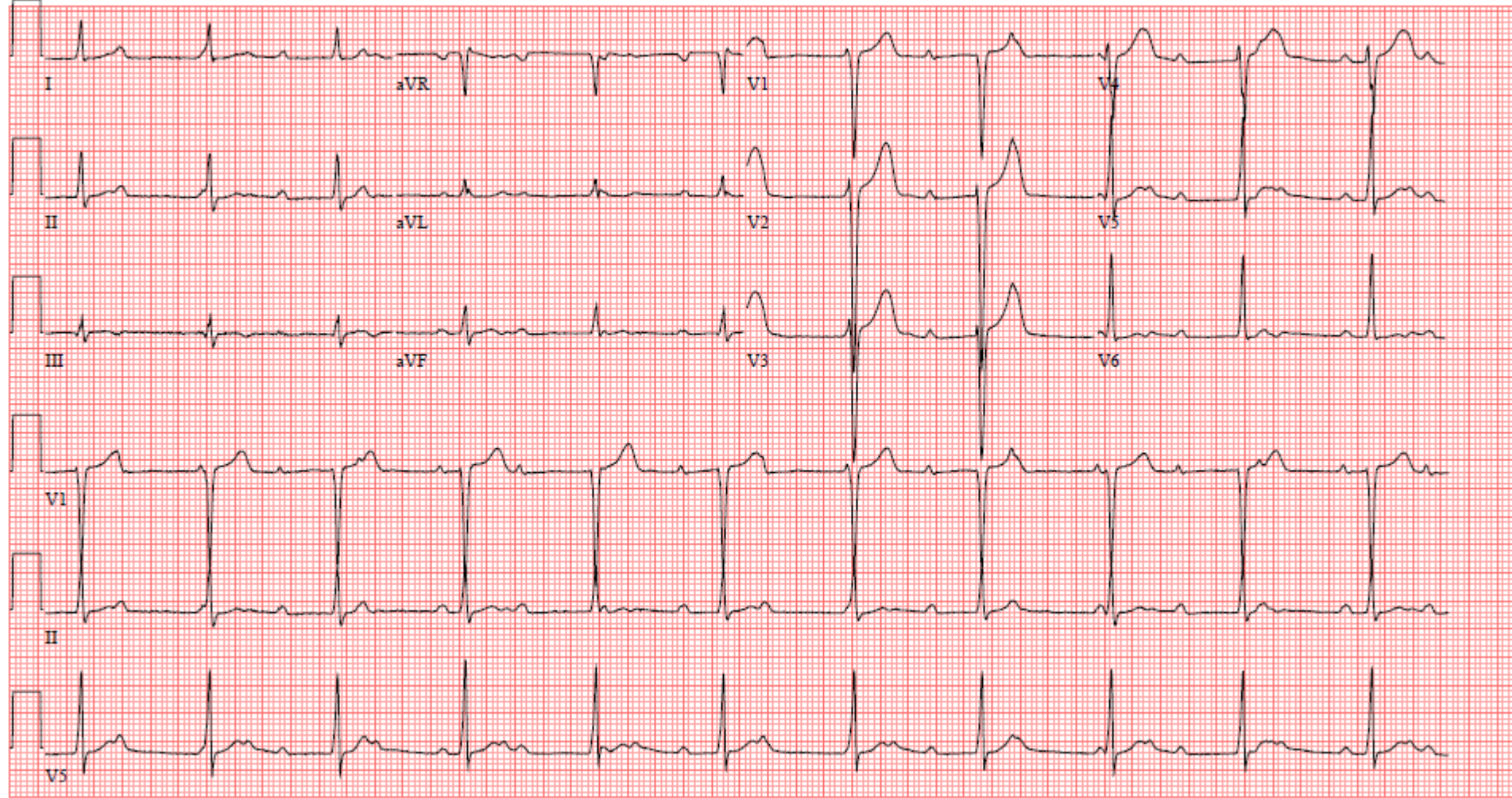
Disclosures

- ▶ I have no financial disclosures relevant to this presentation.
 - ▶ I will reference non-FDA approved indications for medications during this presentation.
- 

Case 1

- ▶ 16 year old male developed heart palpitations 4 days PTA.
 - ▶ 1 day PTA felt fatigued and had mild chest pain, rash on shoulders
 - ▶ Day of admission, lightheaded nearly to the point of fainting
 - ▶ To ED: HR 63
- 

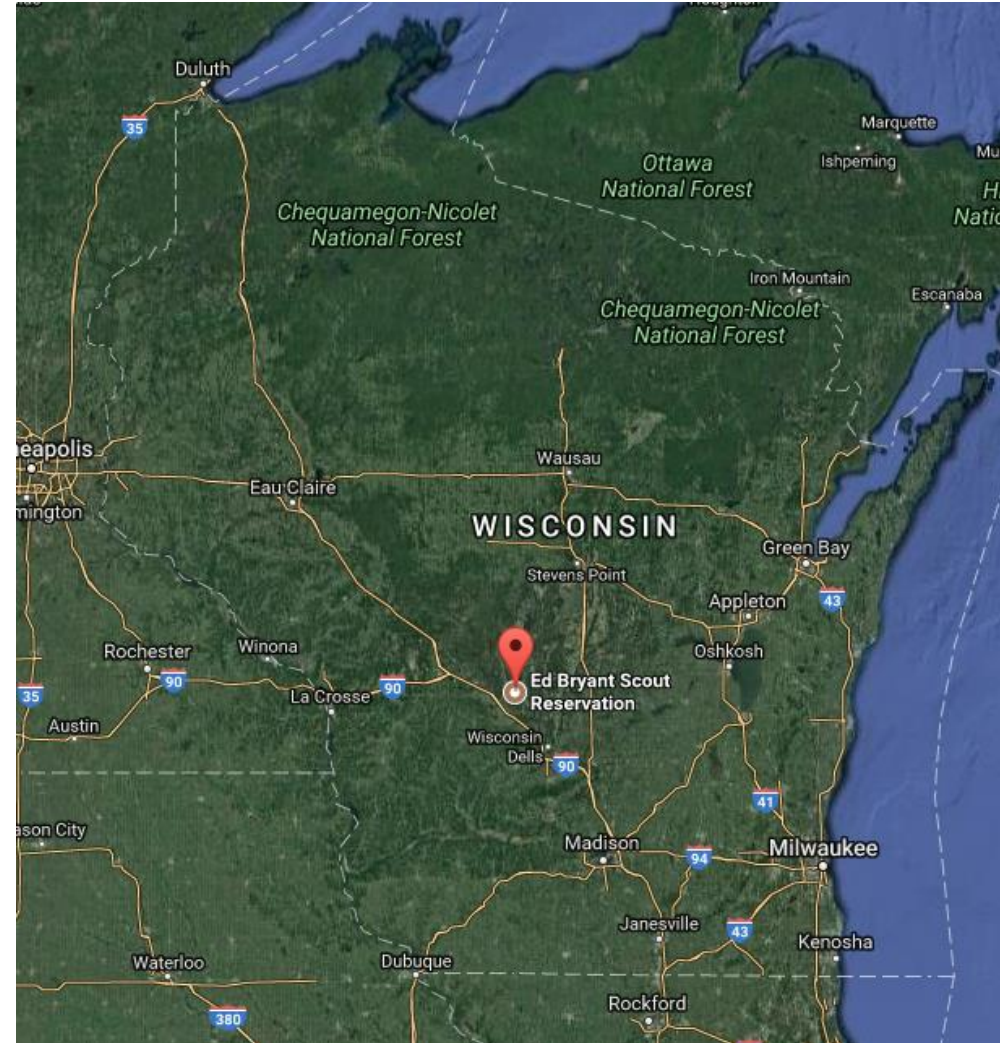
Comments::



Case 1



Photo: Parker Schimler




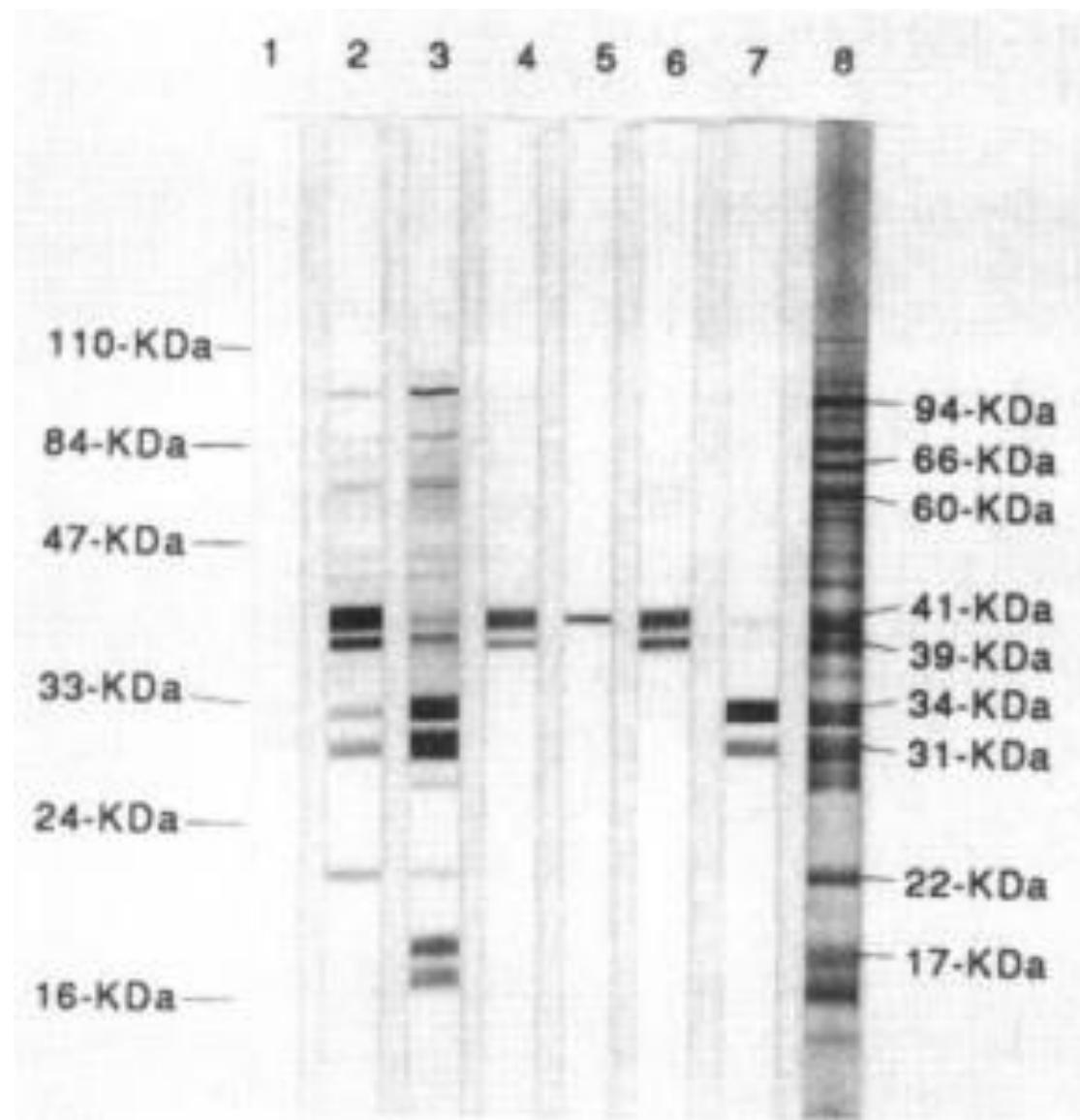
Google Maps





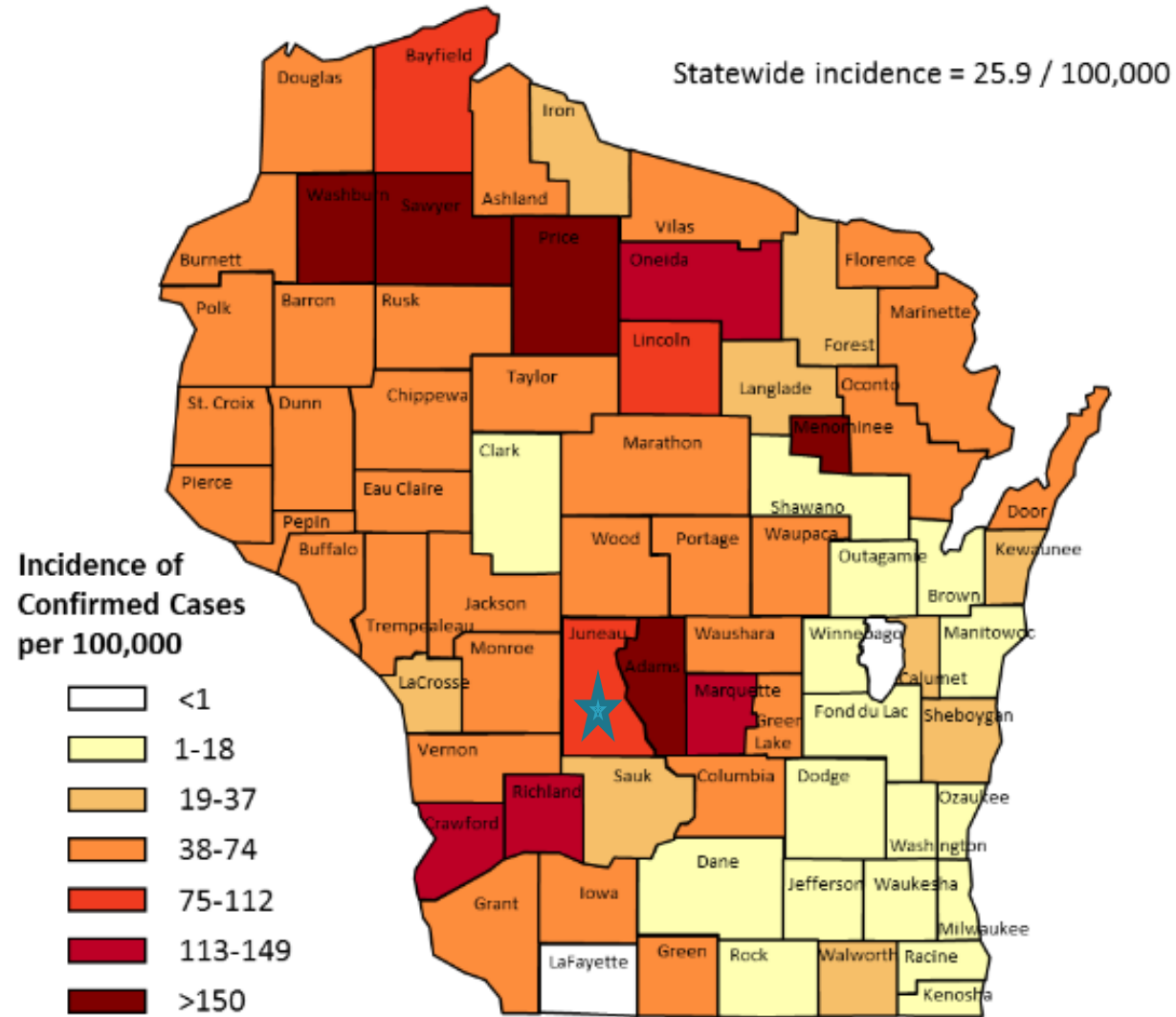
Case 1

- ▶ Lyme Elisa antibody screen – positive
 - ▶ Confirmatory Western Blot
 - IgM – 3 of 3 bands (2 of 3 positive)
 - IgG – 9 of 10 bands (5 of 10 positive)
 - ▶ Diagnosis – Lyme carditis with complete heart block
 - ▶ Treatment – IV ceftriaxone 14 days
- 



Source: CDC

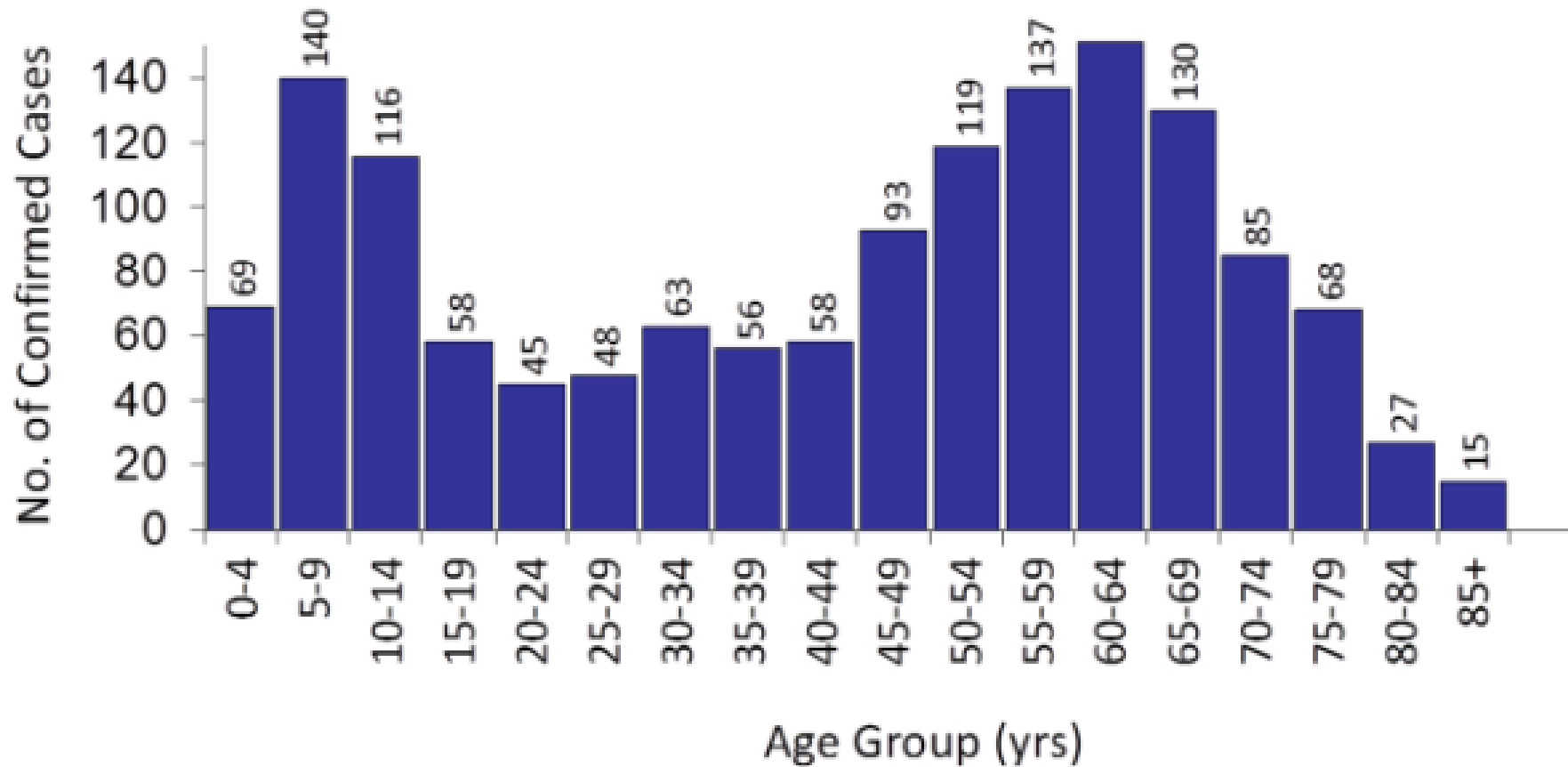
Wisconsin Lyme Disease Total Confirmed Annual Incidence 2016



This map is based on the county of residence of confirmed cases. Some infections may have been acquired during travel to other areas.

Confirmed Lyme Disease Cases

Reported by Age Group – Wisconsin 2016 ($n=1,491$)



Source: Wis Div Health

Manifestations of Lyme Disease

▶ Early Localized

- Erythema migrans
 - Single
- Other symptoms
 - Fatigue – 54%
 - Anorexia – 26%
 - Neck Stiffness – 35%
 - Myalgias – 44%
 - Arthralgia – 44%
 - Adenopathy – 23%
 - Fever – 16%

▶ Early Disseminated

- Multiple EM lesions
- Cranial nerve VII palsy
- Aseptic meningitis
- Carditis
- Ocular

▶ Late

- Arthritis
 - Pauciarticular
 - Large joints (Knee!)
- Neurologic disease

Treatment of Lyme Disease

Indication	Treatment	Duration, days (range)
Tick bite in the United States	Doxycycline, 200 mg in a single dose ^{a,b} ; (4 mg/kg in children \geq 8 years of age) and/or observation	...
Erythema migrans	Oral regimen ^{c,d}	14 (14–21) ^e
Early neurologic disease		
Meningitis or radiculopathy	Parenteral regimen ^{c,f}	14 (10–28)
Cranial nerve palsy ^{a,g}	Oral regimen ^c	14 (14–21)
Cardiac disease	Oral regimen ^{a,c,h} or parenteral regimen ^{a,c,h}	14 (14–21)
Borrelial lymphocytoma	Oral regimen ^{c,d}	14 (14–21)
Late disease		
Arthritis without neurologic disease	Oral regimen ^c	28
Recurrent arthritis after oral regimen	Oral regimen ^{a,c} or parenteral regimen ^{a,c}	28 14 (14–28)
Antibiotic-refractory arthritis ⁱ	Symptomatic therapy ^j	...
Central or peripheral nervous system disease	Parenteral regimen ^c	14 (14–28)
Acrodermatitis chronica atrophicans	Oral regimen ^c	21 (14–28)
Post-Lyme disease syndrome	Consider and evaluate other potential causes of symptoms; if none is found, then administer symptomatic therapy ^a	...

Table 2. Recommended antimicrobial regimens for treatment of patients with Lyme disease.

Drug	Dosage for adults	Dosage for children
Preferred oral regimens		
Amoxicillin	500 mg 3 times per day ^a	50 mg/kg per day in 3 divided doses (maximum, 500 mg per dose) ^a
Doxycycline	100 mg twice per day ^b	Not recommended for children aged <8 years For children aged ≥8 years, 4 mg/kg per day in 2 divided doses (maximum, 100 mg per dose)
Cefuroxime axetil	500 mg twice per day	30 mg/kg per day in 2 divided doses (maximum, 500 mg per dose)
Alternative oral regimens		
Selected macrolides ^c	For recommended dosing regimens, see footnote <i>d</i> in table 3	For recommended dosing regimens, see footnote in table 3
Preferred parenteral regimen		
Ceftriaxone	2 g intravenously once per day	50–75 mg/kg intravenously per day in a single dose (maximum, 2 g)
Alternative parenteral regimens		
Cefotaxime	2 g intravenously every 8 h ^d	150–200 mg/kg per day intravenously in 3–4 divided doses (maximum, 6 g per day) ^d
Penicillin G	18–24 million U per day intravenously, divided every 4 h ^d	200,000–400,000 U/kg per day divided every 4 h ^d (not to exceed 18–24 million U per day)

^a Although a higher dosage given twice per day might be equally as effective, in view of the absence of data on efficacy, twice-daily administration is not recommended.

^b Tetracyclines are relatively contraindicated in pregnant or lactating women and in children <8 years of age.

^c Because of their lower efficacy, macrolides are reserved for patients who are unable to take or who are intolerant of tetracyclines, penicillins, and cephalosporins.

^d Dosage should be reduced for patients with impaired renal function.

Antibiotic prophylaxis after tick bite

- ▶ Overall risk low– 1–3%
- ▶ Lack of data on amoxicillin
- ▶ Testing tick has poor predictability
- ▶ Most exposures do not require prophylaxis
- ▶ IDSA Recommendations for single dose doxycycline
 - Children ≥ 8 yrs
 - *I. scapularis* tick
 - Attached ≥ 36 hrs
 - Abx with 72 hr of removal
 - $\geq 20\%$ of ticks infected
 - Doxy not contraindicated

Ixodes scapularis

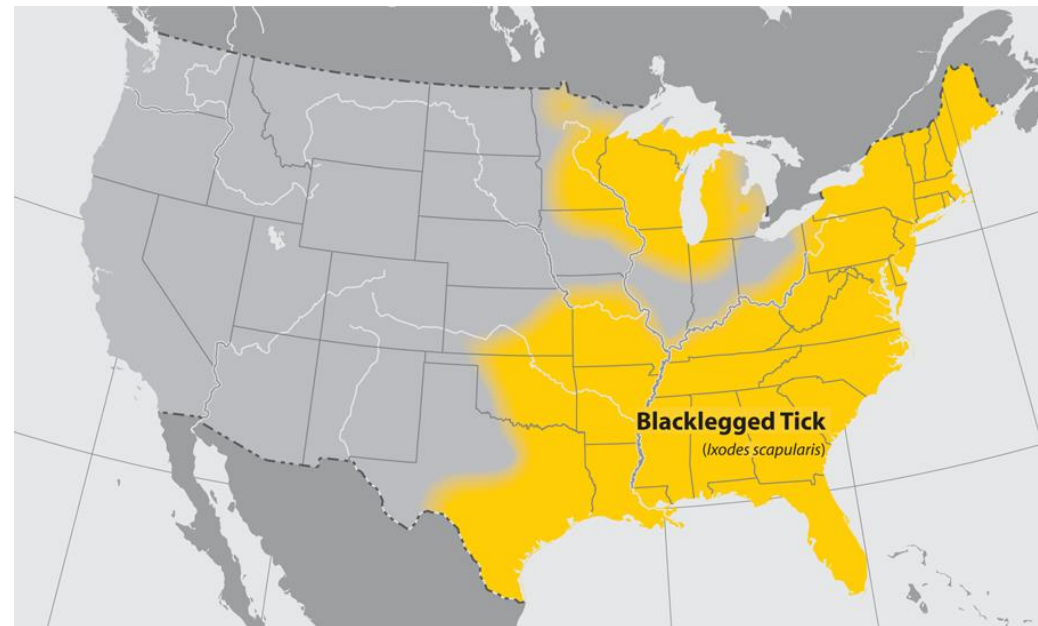
Deer Tick

Bear Tick

Black Legged Tick

Diseases

- ▶ *Borrelia burgdorferi*
- ▶ *Borrelia miyamotoi*
- ▶ *Borrelia mayonii*
- ▶ *Babesia microti*
- ▶ Powassan virus
- ▶ *Anaplasma phagocytophilum*
- ▶ *Ehrlichia muris*



Slide courtesy of Dr. Alana Sterkel WSLH and Tick Encounter Resource center CDC

Dermacentor variabilis

- Wood Tick
- Dog Tick



Diseases

- ▶ Rocky mountain spotted fever
- ▶ Colorado tick fever
- ▶ Tularemia



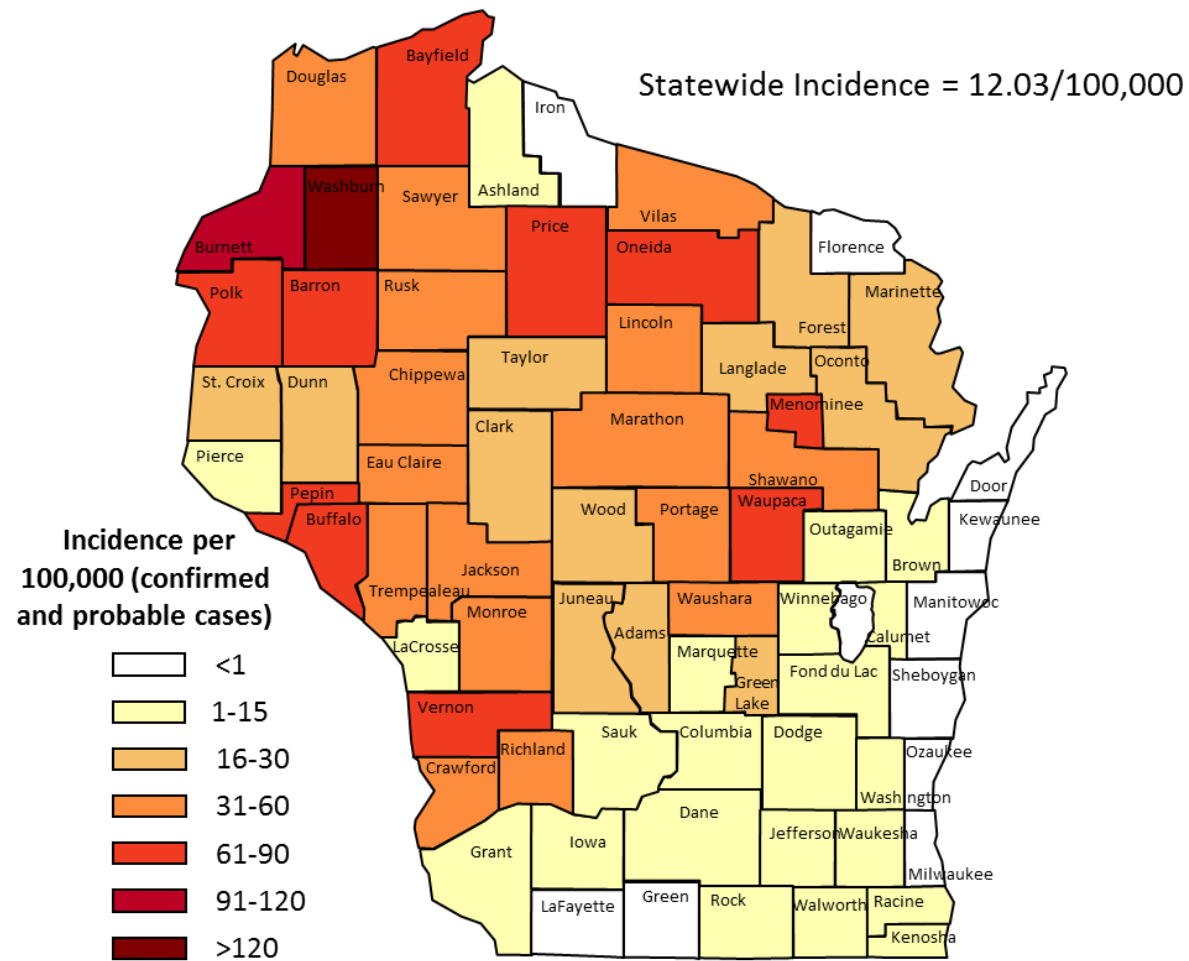
Lyme Caveats

- ▶ If first test ambiguous, repeat in ≥ 2 weeks
- ▶ False positive IgM common (2 bands)
- ▶ Do not test for vague, ill defined symptoms (fatigue, body aches)
- ▶ Most ticks are wood ticks
- ▶ Micro-epidemiology important
- ▶ Consider co-infection
- ▶ Doxycycline at any age >> amoxicillin
- ▶ Evidence is against long term abx (>30 days)
- ▶ Lyme not Lyme's

Questions / Discussion



Wisconsin Ehrlichia/Anaplasma Annual Incidence 2016 (n=694)

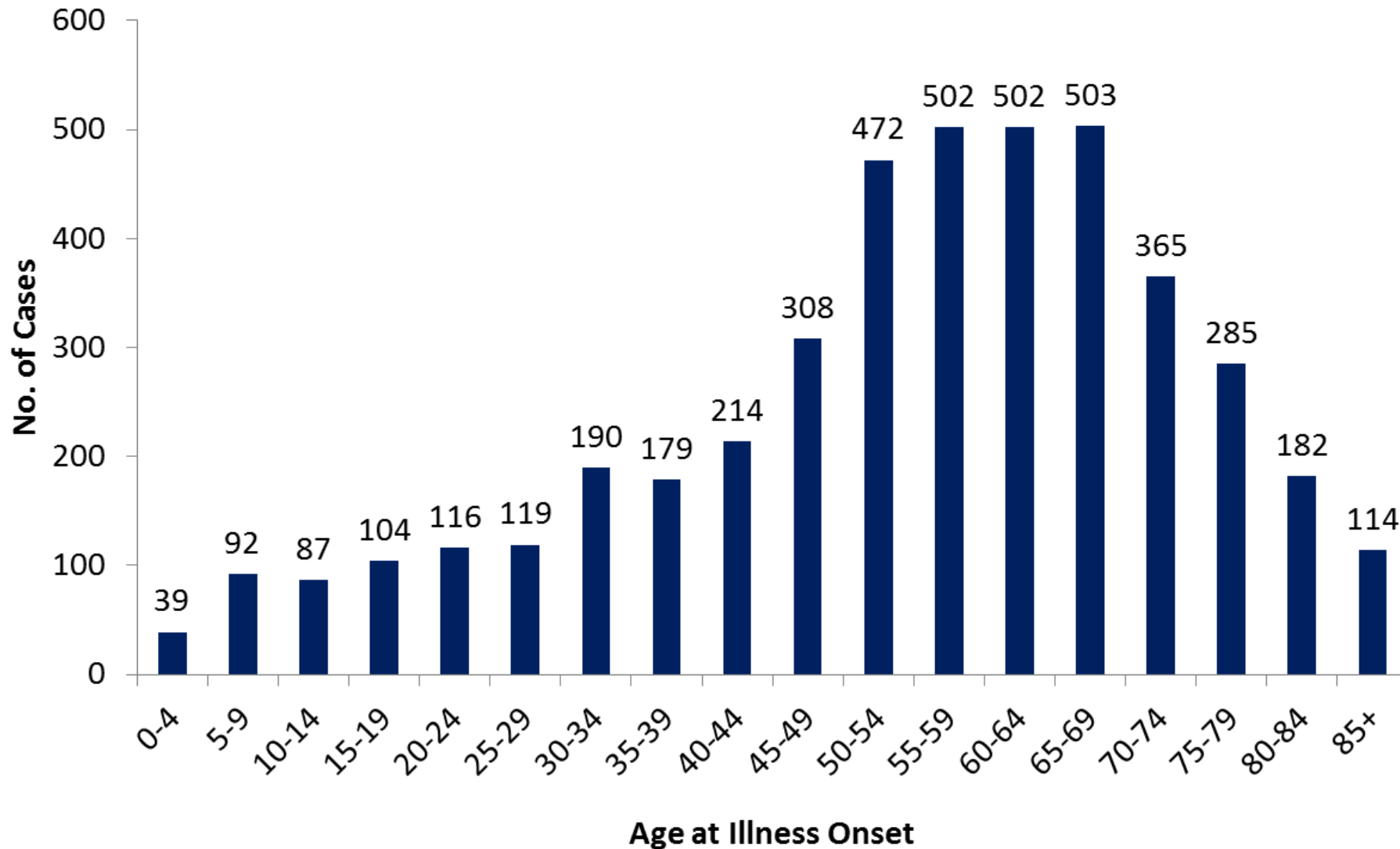


Revised 4/27/2017

This map is based on the county of residence. Some infections may have been acquired during travel to other areas.

Data Source: Wisconsin Division of Public Health

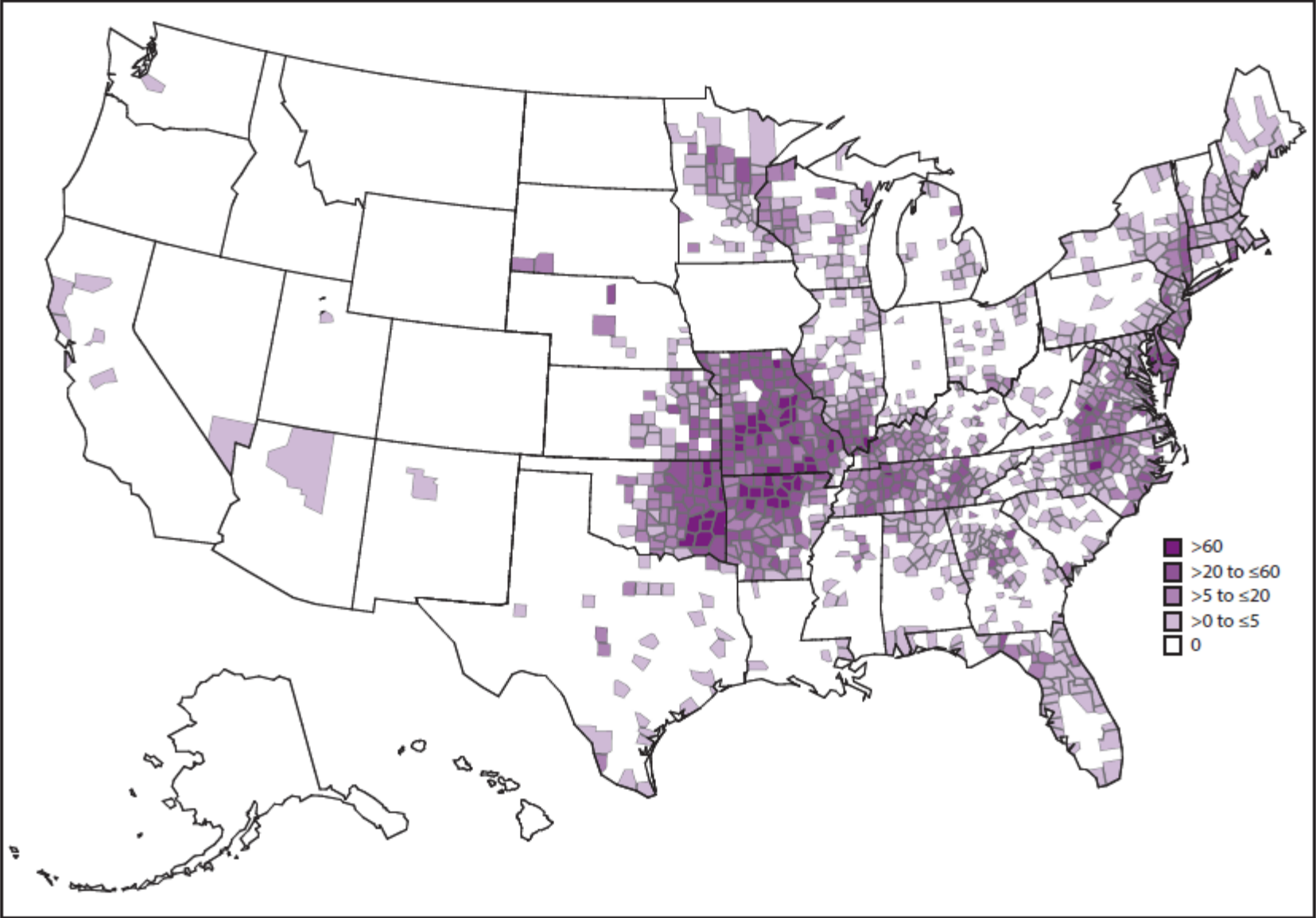
Wisconsin Total Cases of Anaplasmosis/Ehrlichiosis Reported by Age 2008-2016 (n=4,378)



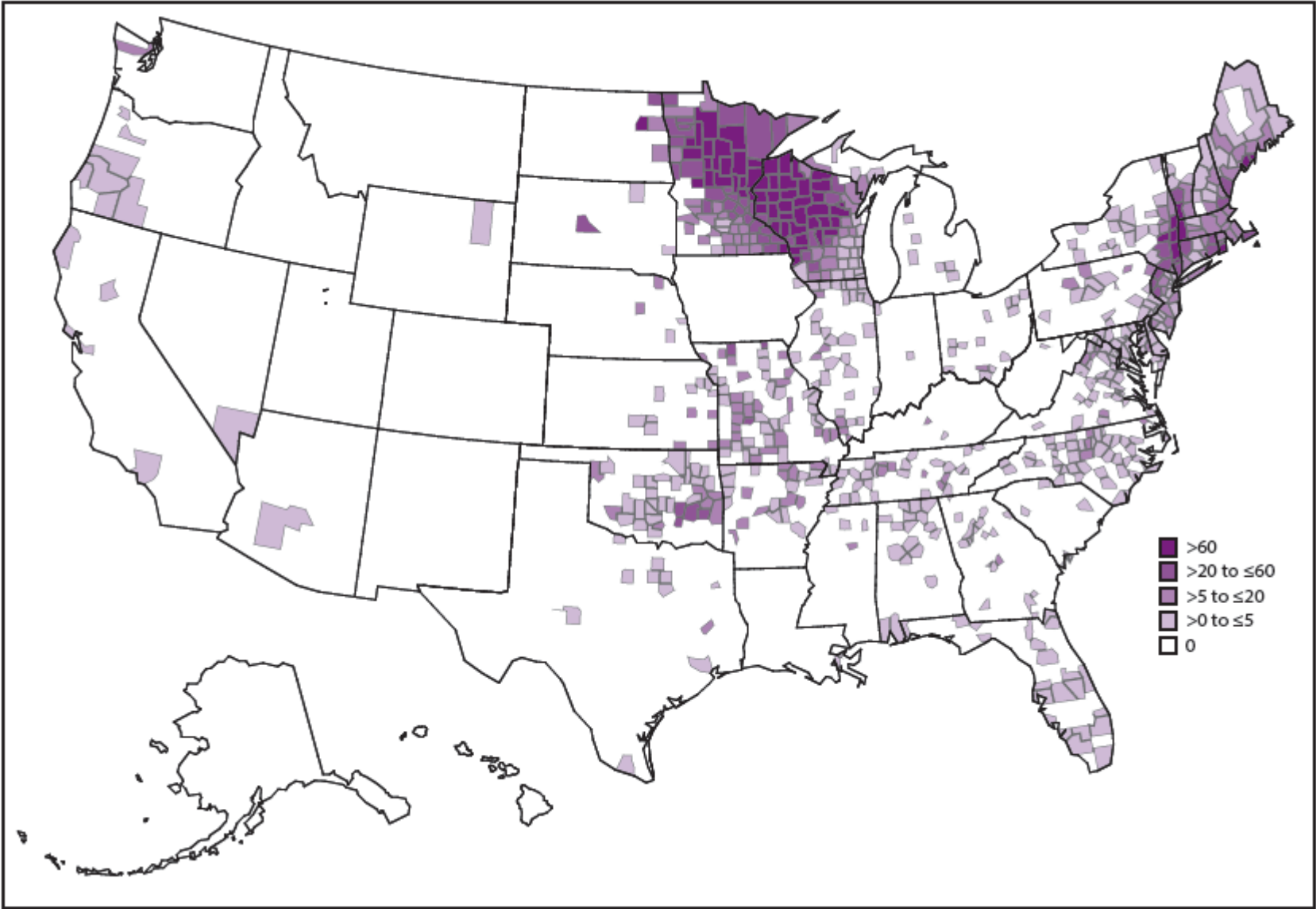
*Total Number of cases include confirmed and probable
Revised 05/02/2017

Data Source: Wisconsin Division of Public Health

Reported incidence rate* of *Ehrlichia chaffeensis* ehrlichiosis, by county — United States, 2000–2013



Reported incidence rate* of anaplasmosis, by county — United States, 2000–2013



Anaplasmosis / Ehrlichiosis

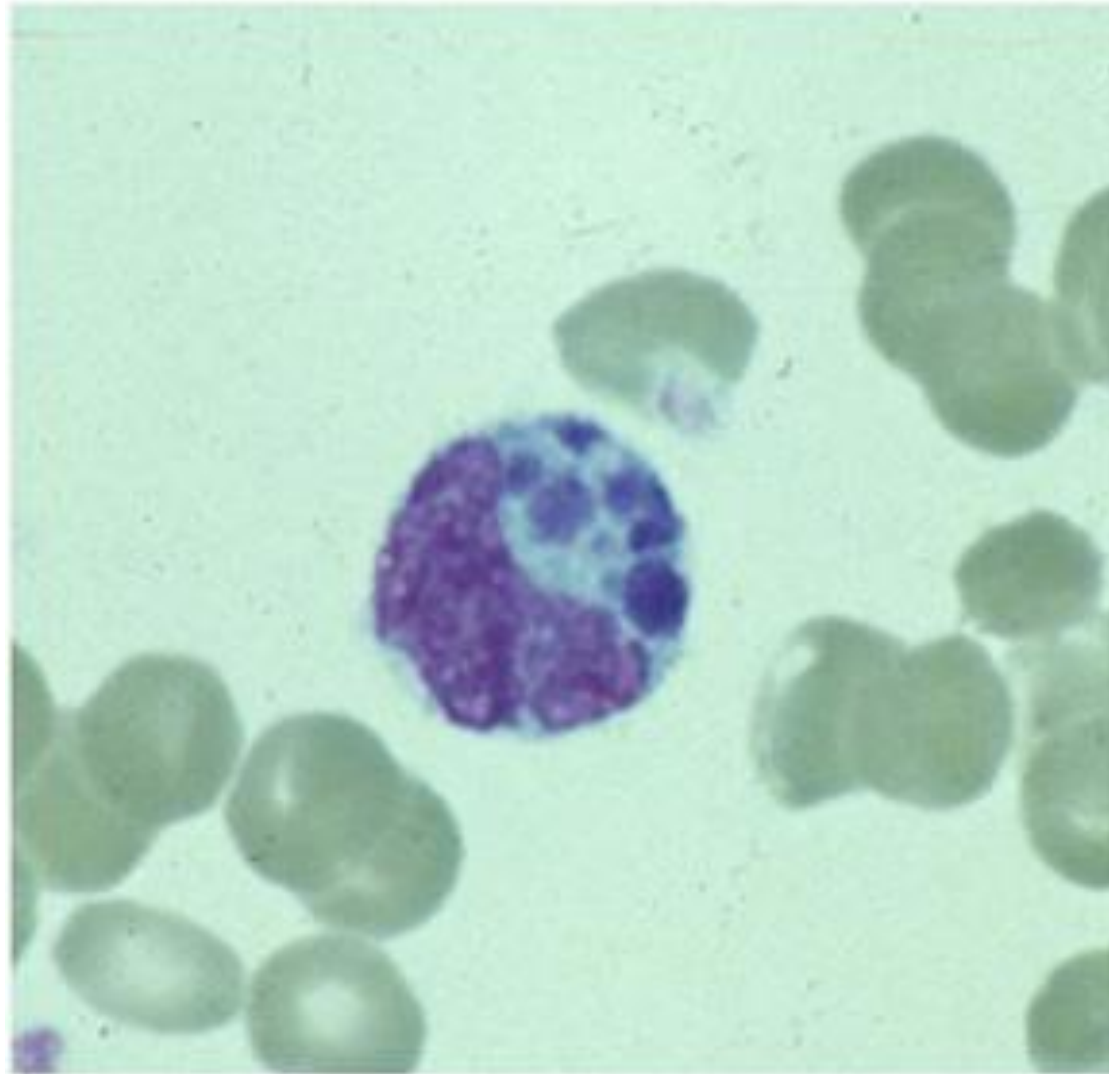
▶ Clinical manifestations

- Fever
- Headache
- Malaise
- Myalgia
- Nausea/vomiting/diarrhea
- Rash (Ehrlichia)
- ARDS
- Encephalopathy
- Meningitis
- DIC
- Renal failure

▶ Lab/diagnosis

- Leukopenia
- Thrombocytopenia
- Increased ALT/AST

- PCR – serum/csf
- Serology – acute and convalescent
- Peripheral smear – morulae

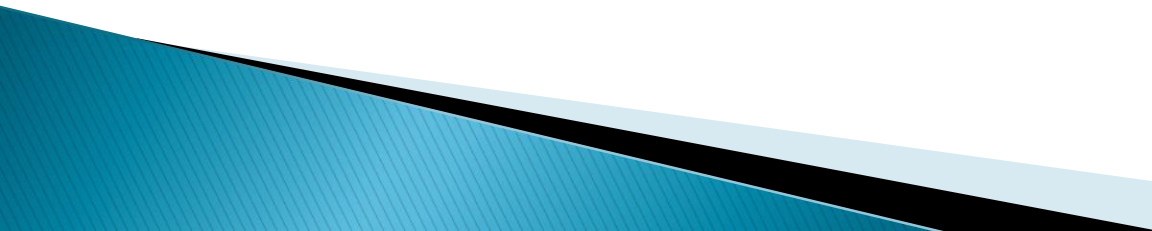


Source: US CDC

Anaplasmosis / Ehrlichiosis

- ▶ Doxycycline
 - 4.4 mg/kg/day divided every 12 hours
 - Maximum/adult dose 100mg/dose
 - 7–14 days
 - If dx suspected should be used regardless of age

Babesiosis

- ▶ Agent: *Babesia microti*
 - Intraerythrocytic protozoa
 - “homegrown malaria”
 - ▶ Vector – deer tick (*Ixodes scapularis*)
 - ▶ Reservoir – white footed mouse (not deer)
- 

Babesiosis

- ▶ Malaise, fatigue, fever
- ▶ Chills/sweats, arthralgia, myalgia,
- ▶ Hypotension, respiratory distress, organomegally, jaundice
- ▶ Anemia, thrombocytopenia, DIC.
- ▶ Normal host or immunocompromised – esp asplenic

Babesiosis

- ▶ Diagnosis
 - Blood smear
 - Serology
 - Serum PCR
- ▶ Treatment
 - Clindmycin+quinine
 - atovaquone+azithromycin

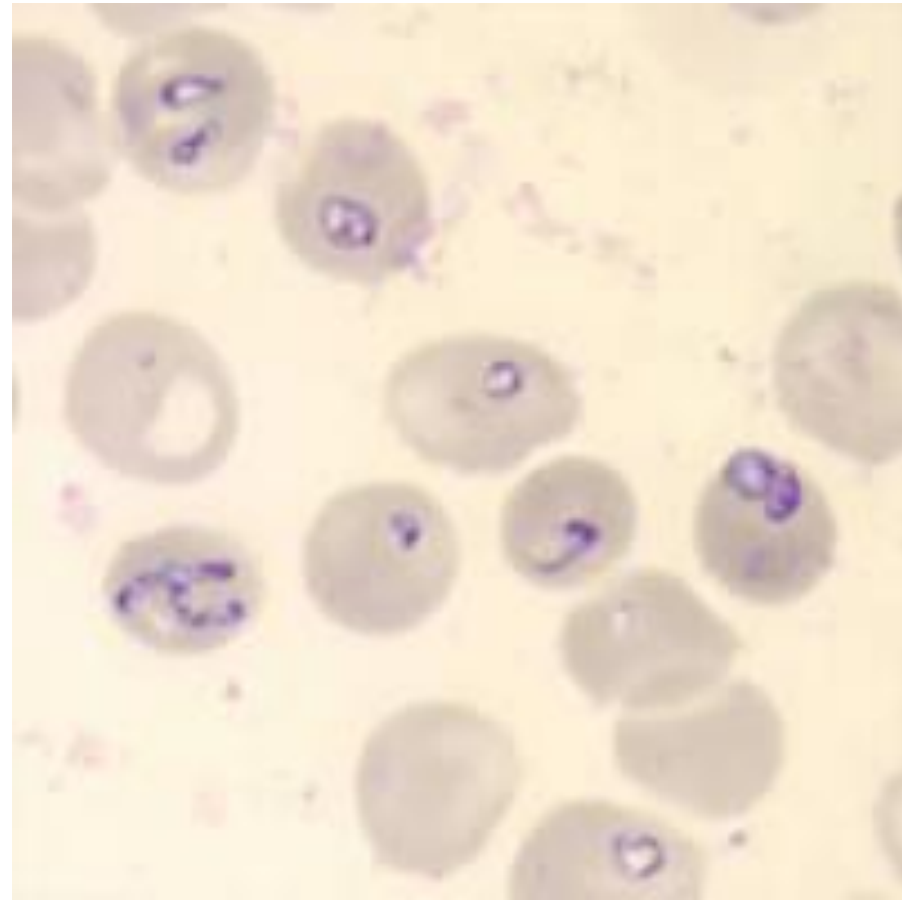
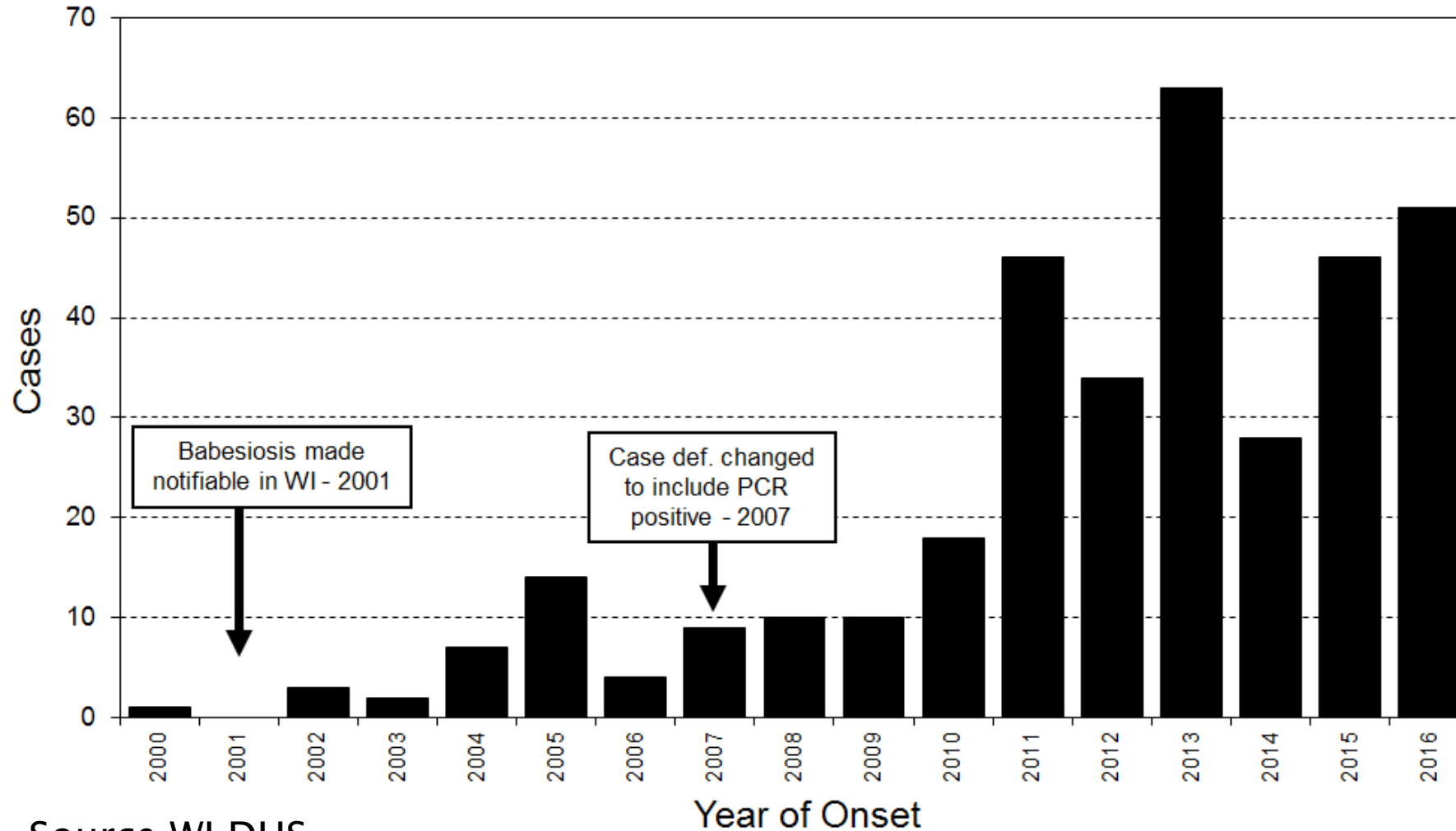


Image: US CDC

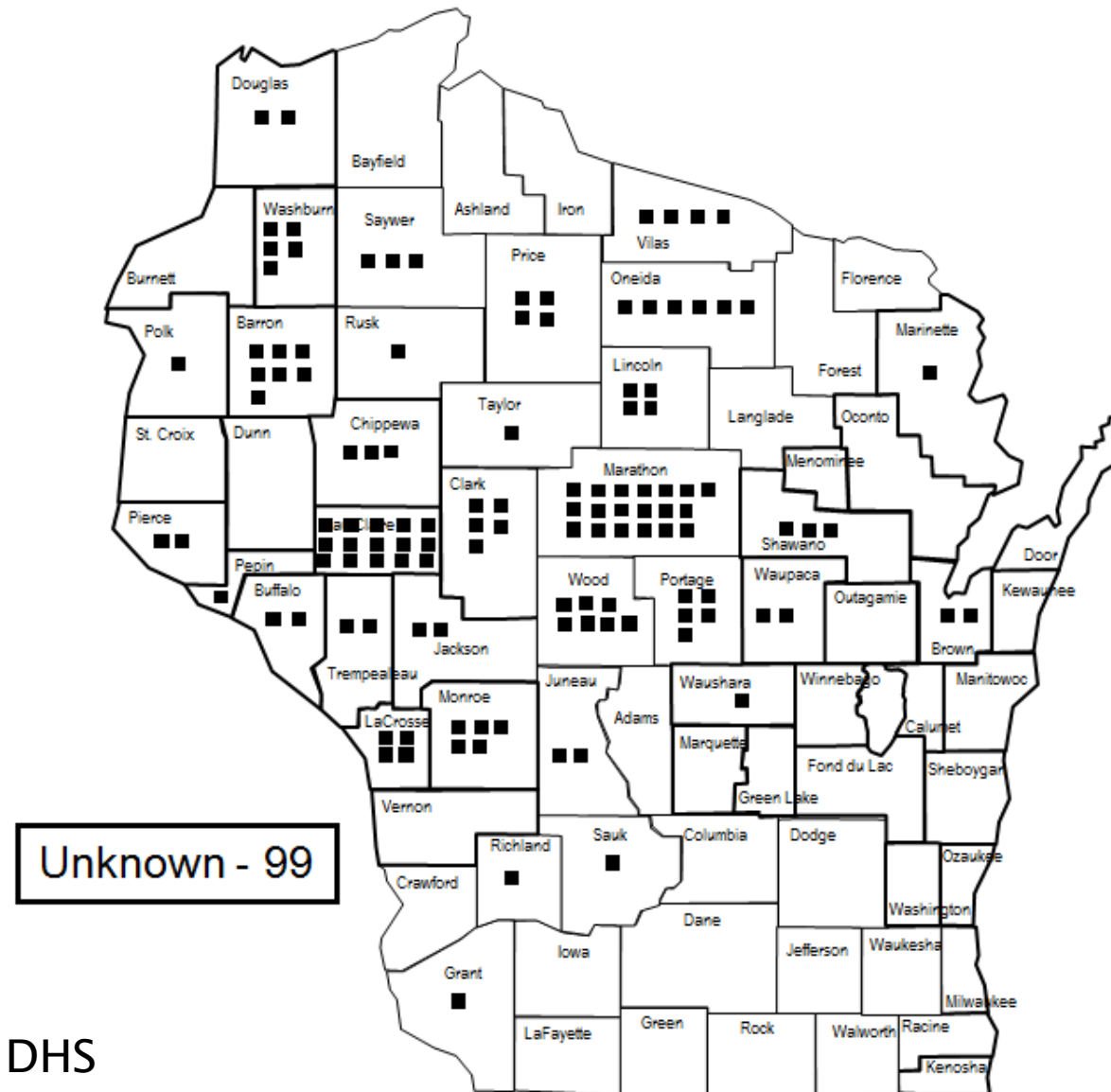
Reported Confirmed Babesiosis, Wisconsin 2000–2016



Source WI DHS


Confirmed Babesiosis, Wisconsin, 2012-2016

County of Likely Exposure (n=223)



Source WI DHS

Case 3

- ▶ 14 year old male 2 weeks prior sore throat and lump on neck
 - ▶ 1 day later purple rash on palms, then arms and legs
 - ▶ Fever to 103.5
 - ▶ Seen in urgent care, RST, CBC normal
 - ▶ 2 days later headache and bilateral red eyes
 - ▶ NO significant travel or exposures
 - ▶ Southcentral WI rural subdivision
- 


Case 3

- ▶ Exam
 - Afebrile
 - Conjunctival injection bilateral
 - Rash on extremities

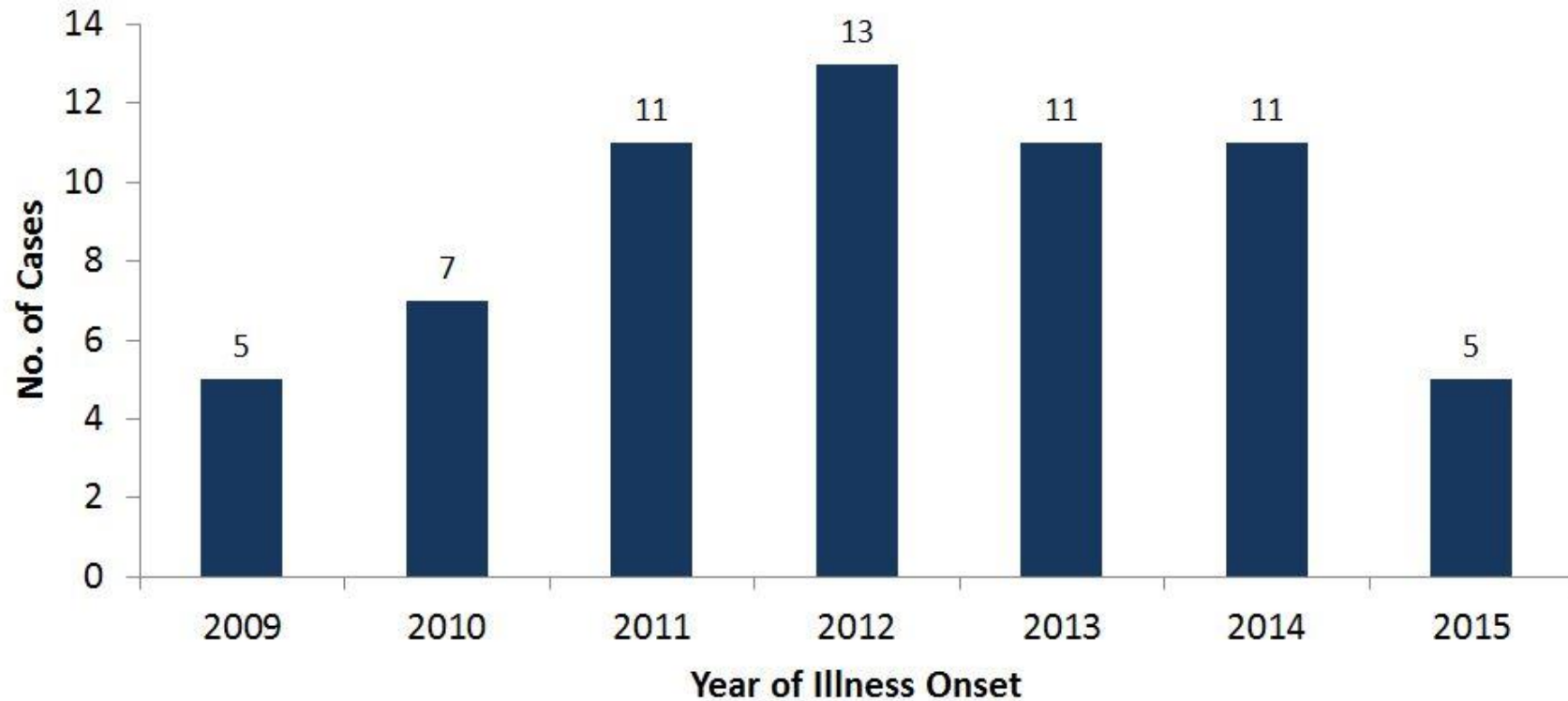


Source: US CDC

Case 3

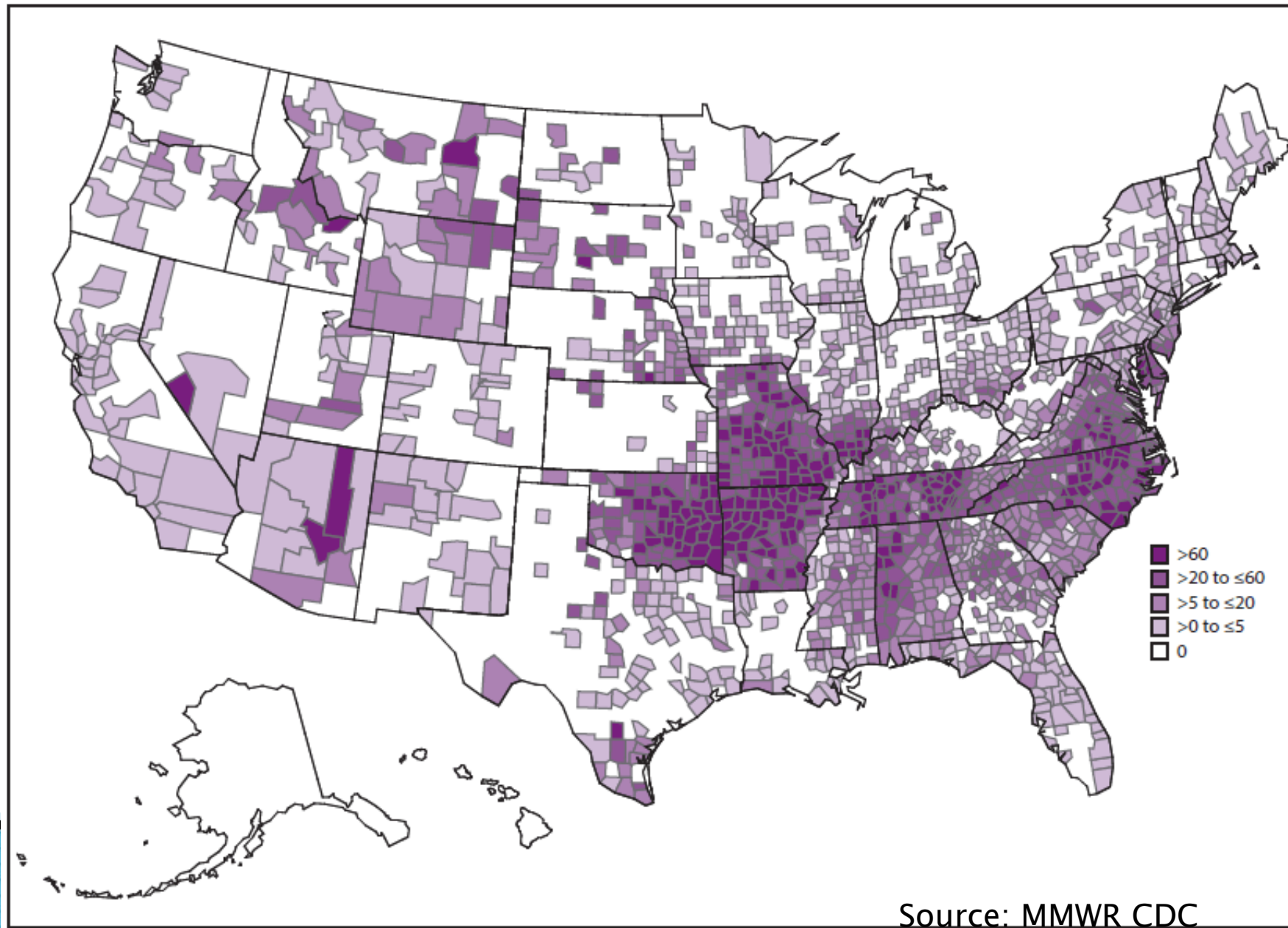
- ▶ Started by PCP on doxycycline over concern for rickettsial infection
 - ▶ Rocky Mountain Spotted fever serology: 1:160
 - ▶ Completed 10 day course
- 

Wisconsin Reported Total Cases of Rocky Mountain Spotted Fever 2009-2015 (n=63)



Data Source: Wisconsin Division of Public Health

FIGURE 1. Reported incidence rate* of spotted fever rickettsiosis,† by county — United States, 2000–2013

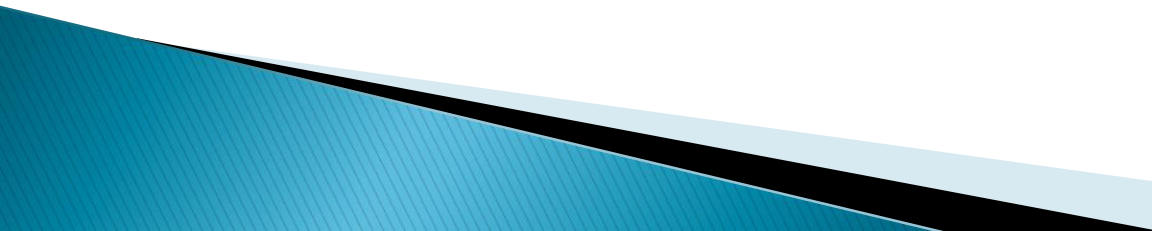


Rocky Mountain Spotted Fever

- ▶ Cause: *Rickettsia rickettsii*
- ▶ Vector: Wood tick (*Dermacentor variabilis*)
- ▶ Diagnosis – serology
- ▶ Treatment: Doxycycline, early, regardless of age.



Case 4

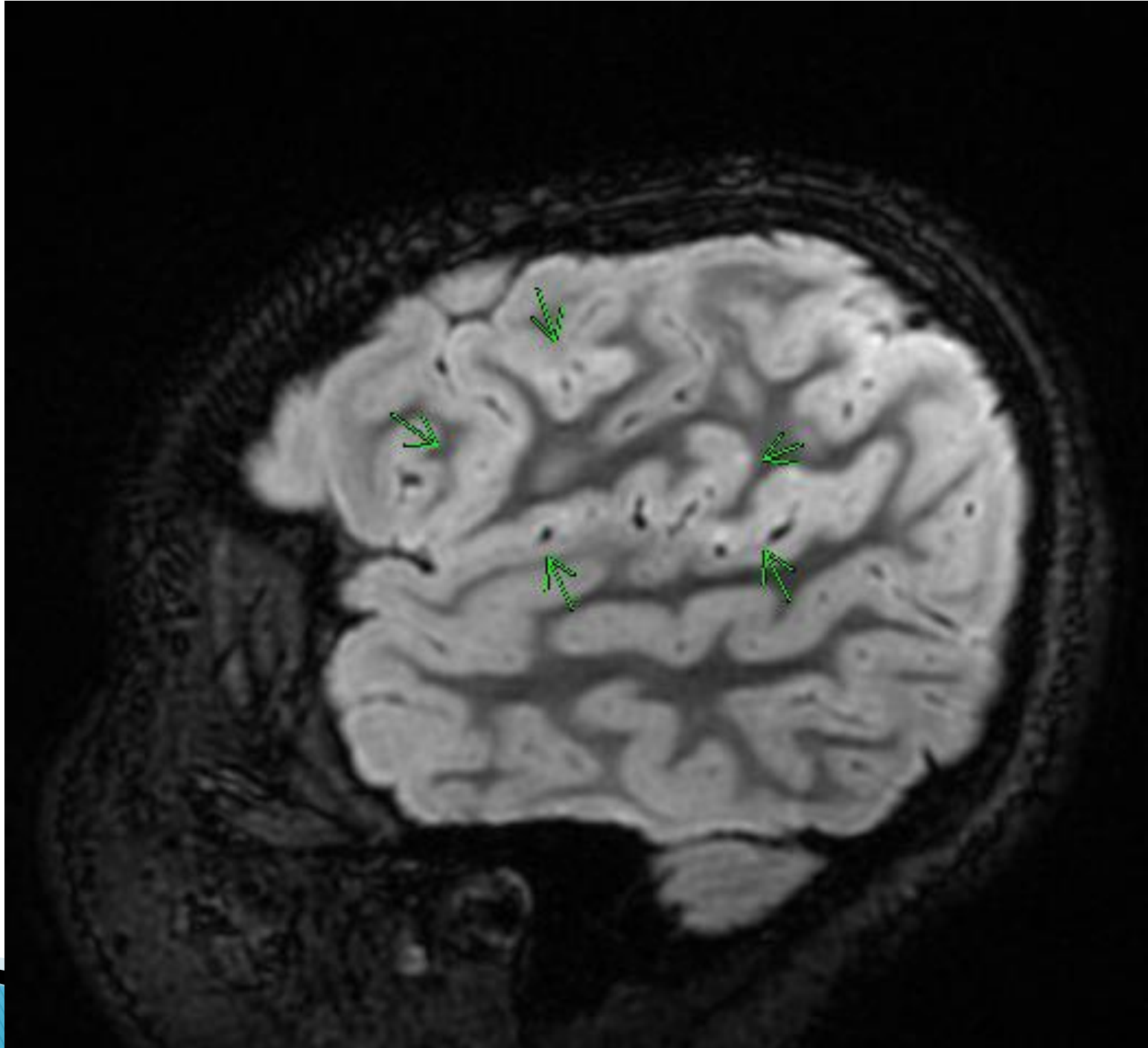
- ▶ 9 yr old boy previously well, who presented late July with left frontal headache
 - ▶ Felt warm temp to 101.3
 - ▶ Brother with fever
 - ▶ Fell on ground and had a generalized tonic– clonic seizure lasting 10 min
 - ▶ Vomited after seizure
- 

Case 4

▶ Exam

- Febrile to 101
- alert and awakened
- Right sided facial twitching and leftward eye deviation

- ## ▶ MRI head: gyriform restricted diffusion with superficial nodularity along the left cerebral convexity c/w atypical viral vs fungal infection

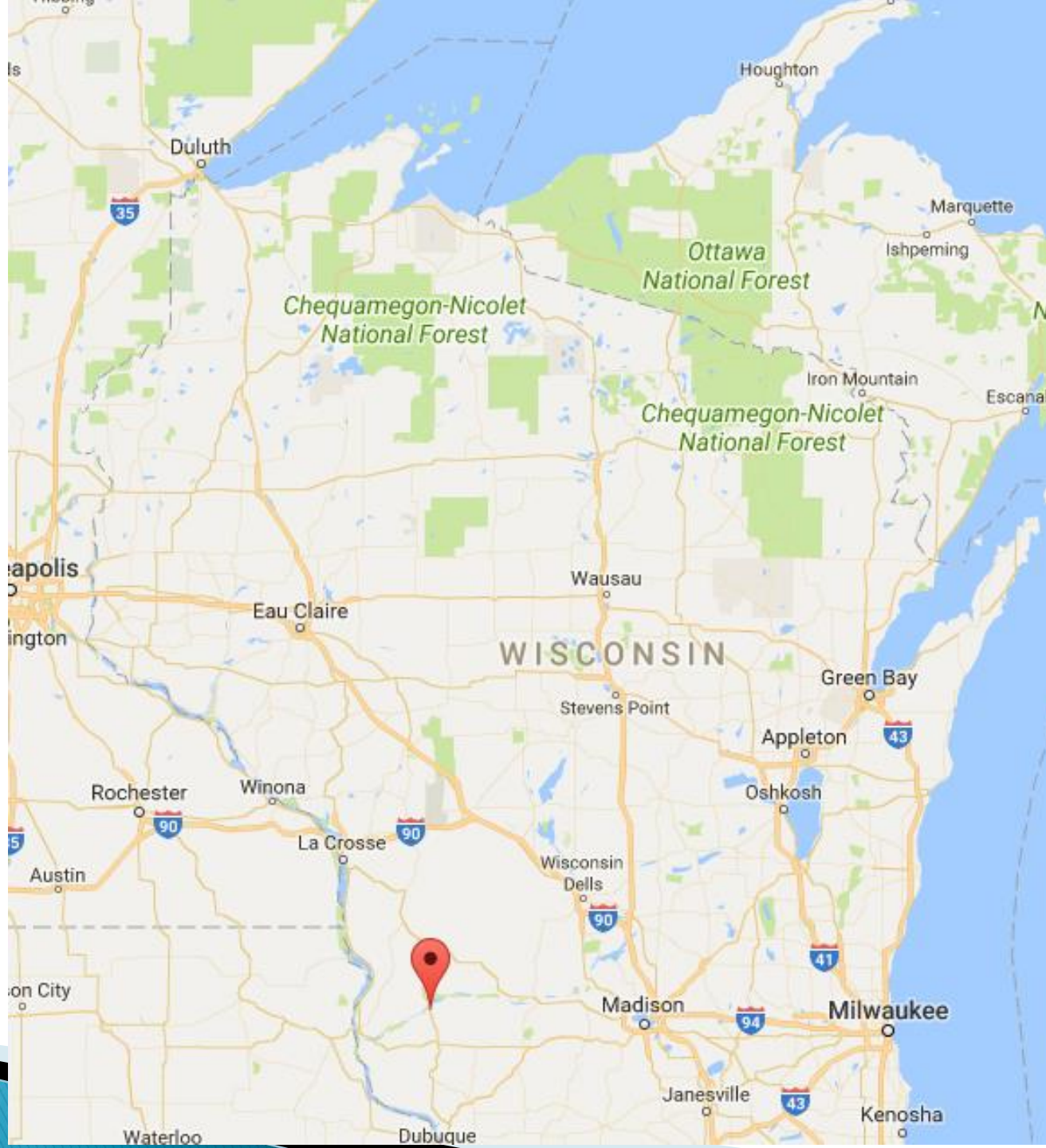


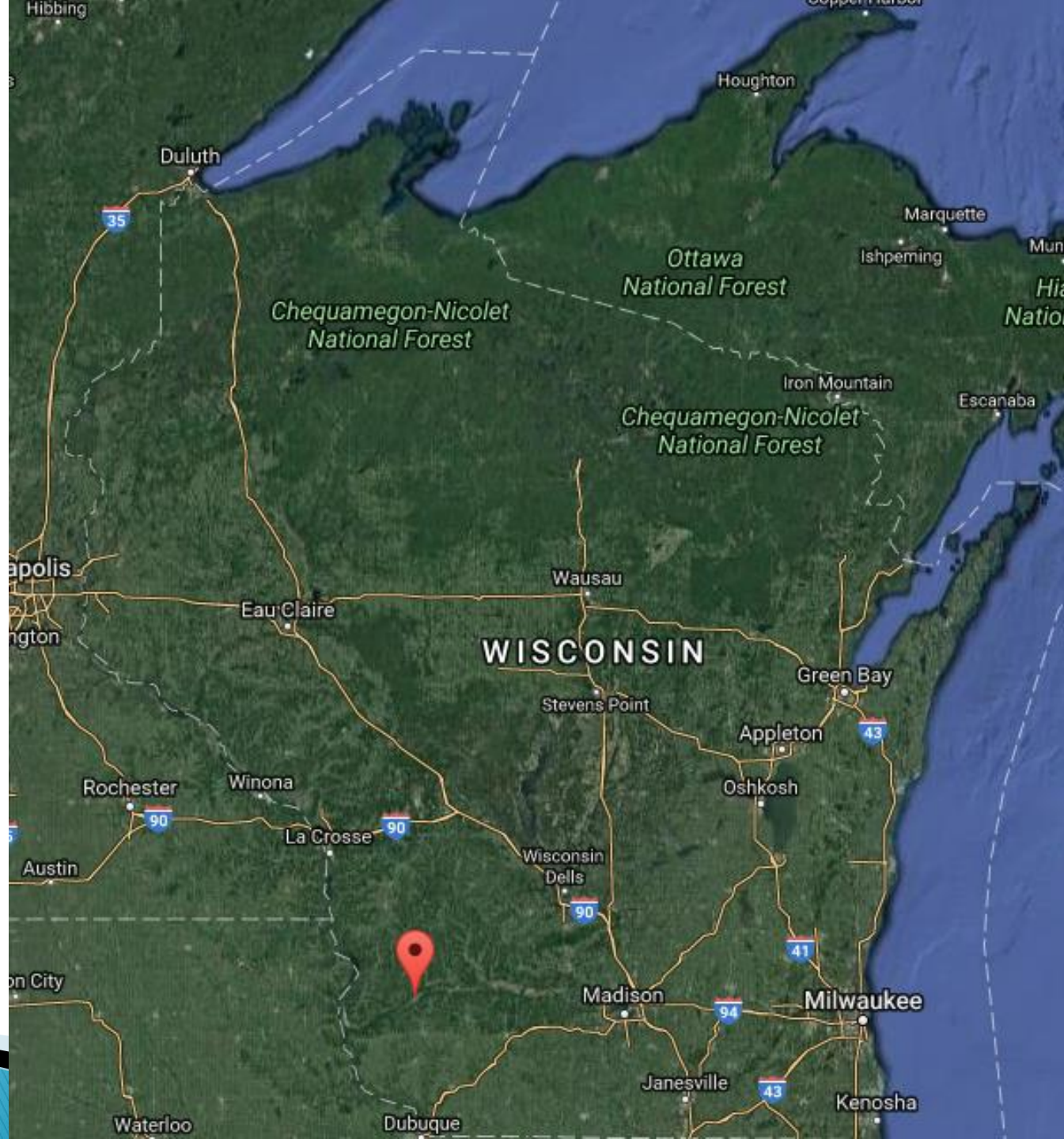
Case 4

- ▶ CSF
 - 118 nucleated cells – 9N/77L/11MP
 - 3 RBCs
 - Glucose 64
 - Protein 32
 - Gram stain and cx negative

Case 4

- ▶ Enteroviral PCR – neg
- ▶ HSV PCR – neg
- ▶ Serum IgM
 - Eastern Equine Encephalitis – neg
 - Lacrosse Encephalitis – POS (14.16)
 - West Nile Virus – neg
 - St. Louis Encephalitis – neg
 - Jamestown Canyon Virus – POS (3.87)
 - Powassan virus – neg

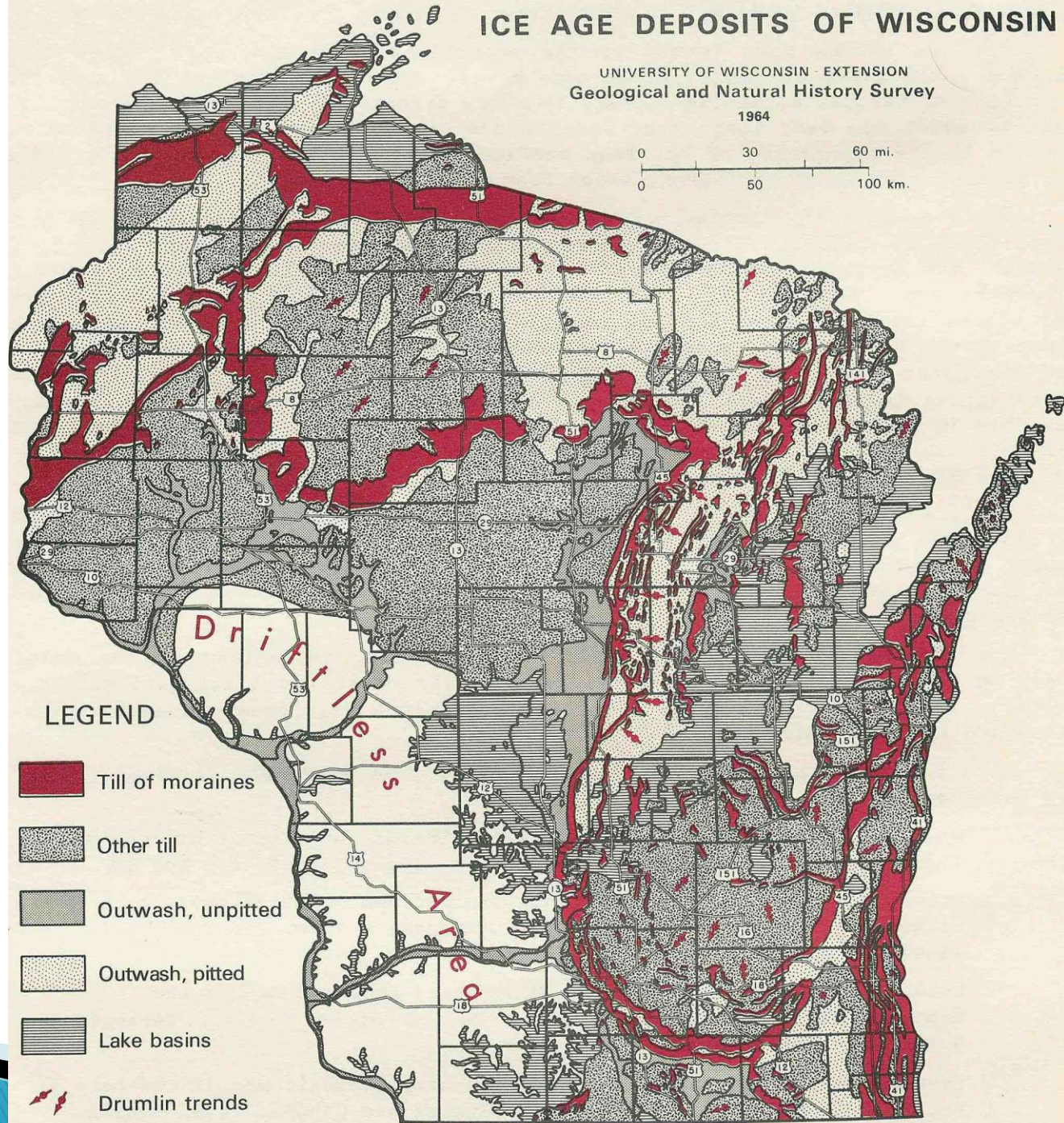
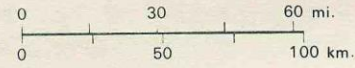










ICE AGE DEPOSITS OF WISCONSIN

UNIVERSITY OF WISCONSIN - EXTENSION
Geological and Natural History Survey

1964



LEGEND

-  Till of moraines
-  Other till
-  Outwash, unpitted
-  Outwash, pitted
-  Lake basins
-  Drumlin trends

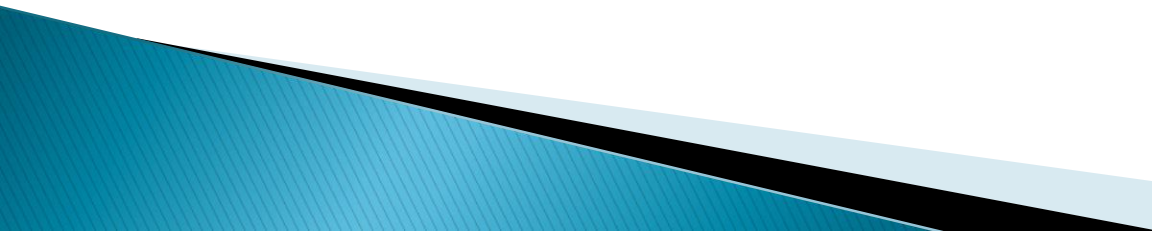
from Thwaites, 1956

modified, 1985

Encephalitis viruses – WI

- ▶ Mosquito borne
 - Lacrosse virus
 - Jamestown Canyon Virus
 - West Nile virus
 - Eastern Equine Encephalitis (very rare)
- ▶ Tick borne (*Ixodes scapularis* – deer tick)
 - Powassan virus (5 cases 2016)

LaCrosse Encephalitis

- ▶ Incubation 3– 7 days
 - ▶ Many infections are asymptomatic
 - ▶ 90% of disease <15 yrs.
 - ▶ Males > females
 - ▶ Recovery is the rule, Mortality <1 %
 - ▶ Emotional lability 10%
 - ▶ Epilepsy 6–10%
- 

LaCrosse

Encephalitis: Epidemiology

▶ Vector

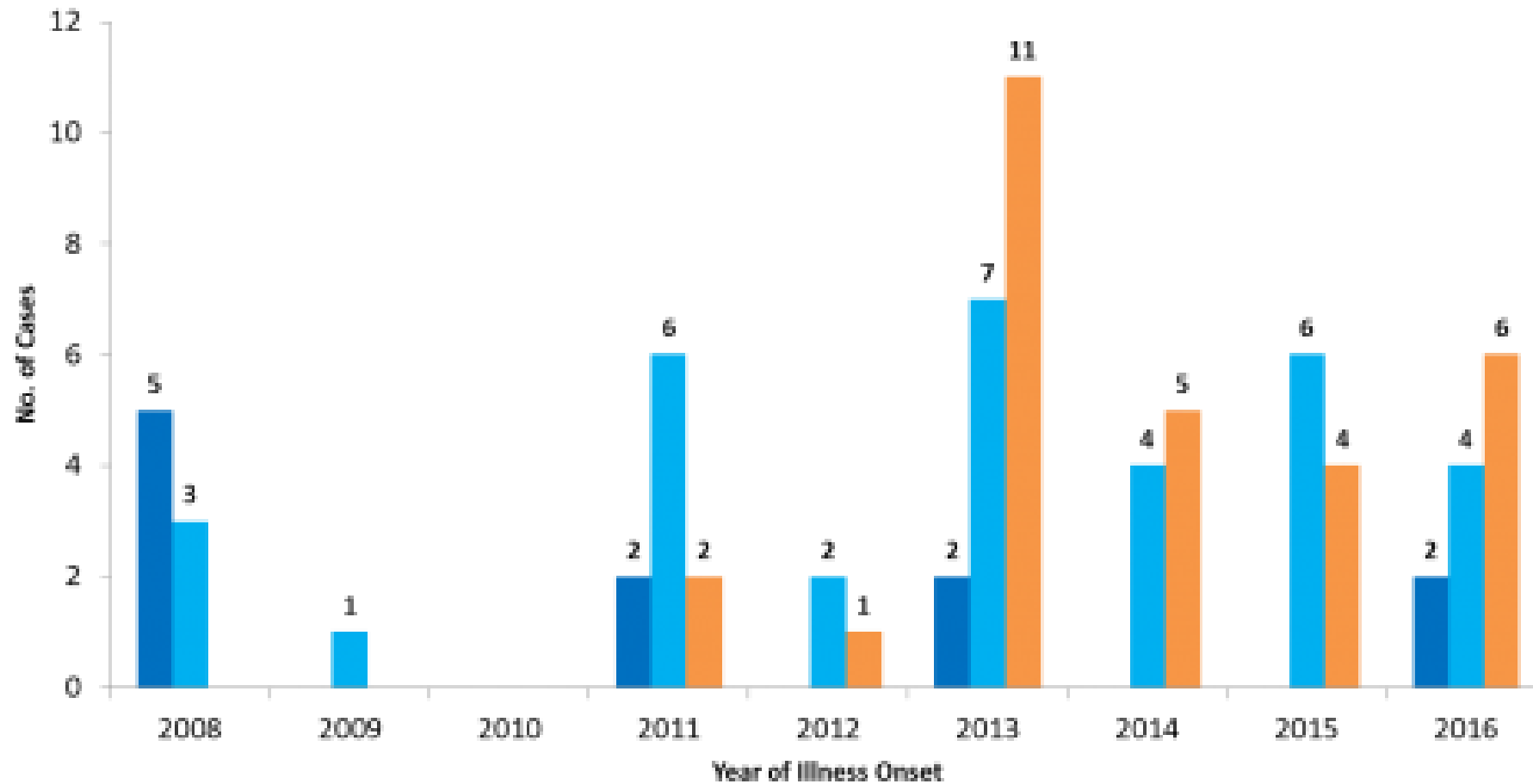
- *Aedes triseriatus*
- “tree hole mosquito”
- reproduces in stagnant water
- tree holes/ old tires/ water containers
- feed on viremic natural hosts

▶ Natural Hosts

- chipmunks
- squirrels
- foxes
- woodchucks



Wisconsin Total Cases of California Serogroup Viruses 2008 - 2016 (n=73)



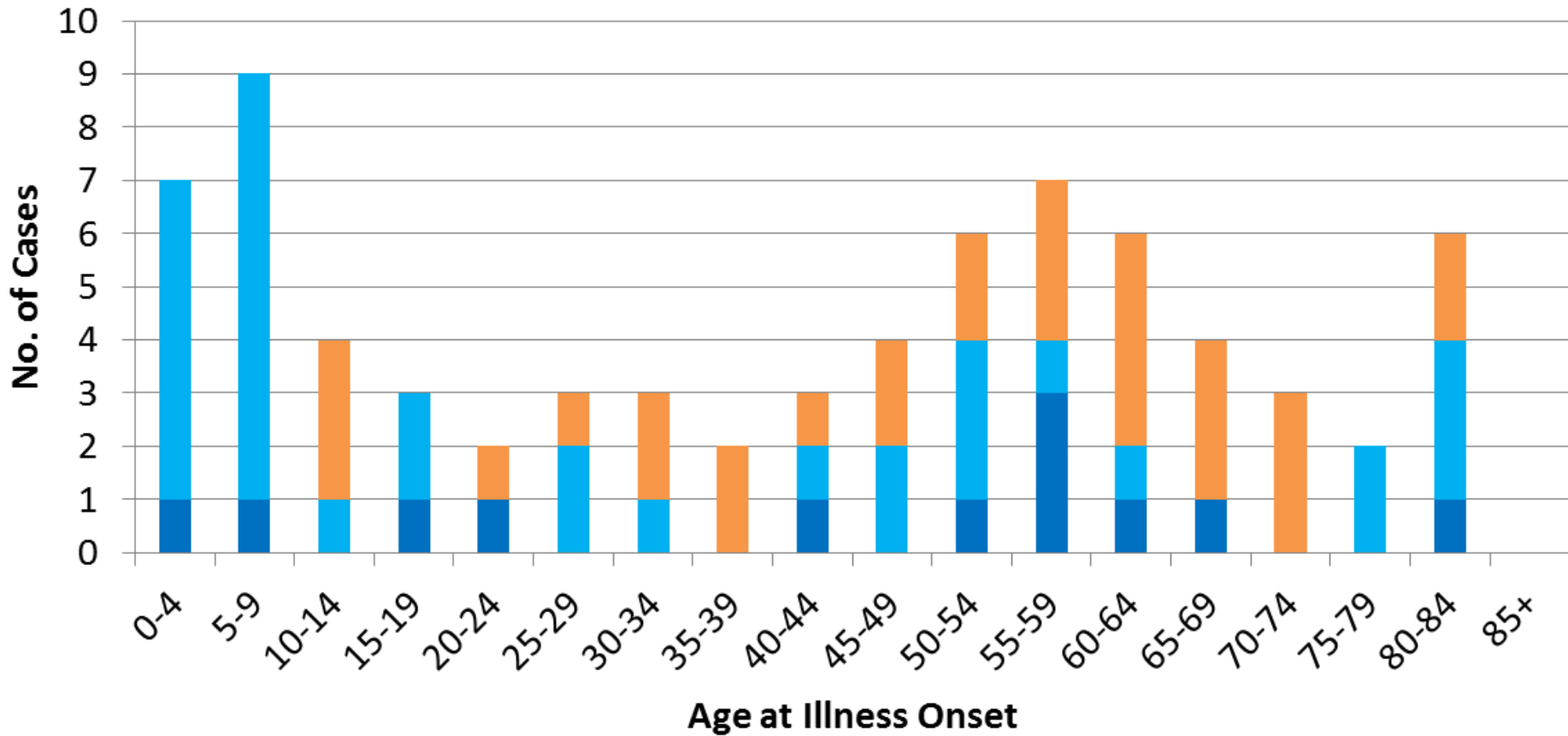
Revised 09/11/2017

■ California ■ La Crosse ■ Jamestown Canyon

Data Source: Wisconsin
Division of Public Health

Figure: WI DHS

Wisconsin Total Cases of California Serogroup Viruses by Age 2008 - 2016 (n=74)



Revised 04/25/2017

■ California
 ■ La Crosse
 ■ Jamestown Canyon

Data Source: Wisconsin
Division of Public Health

WI Non arboviral infections

Case 5

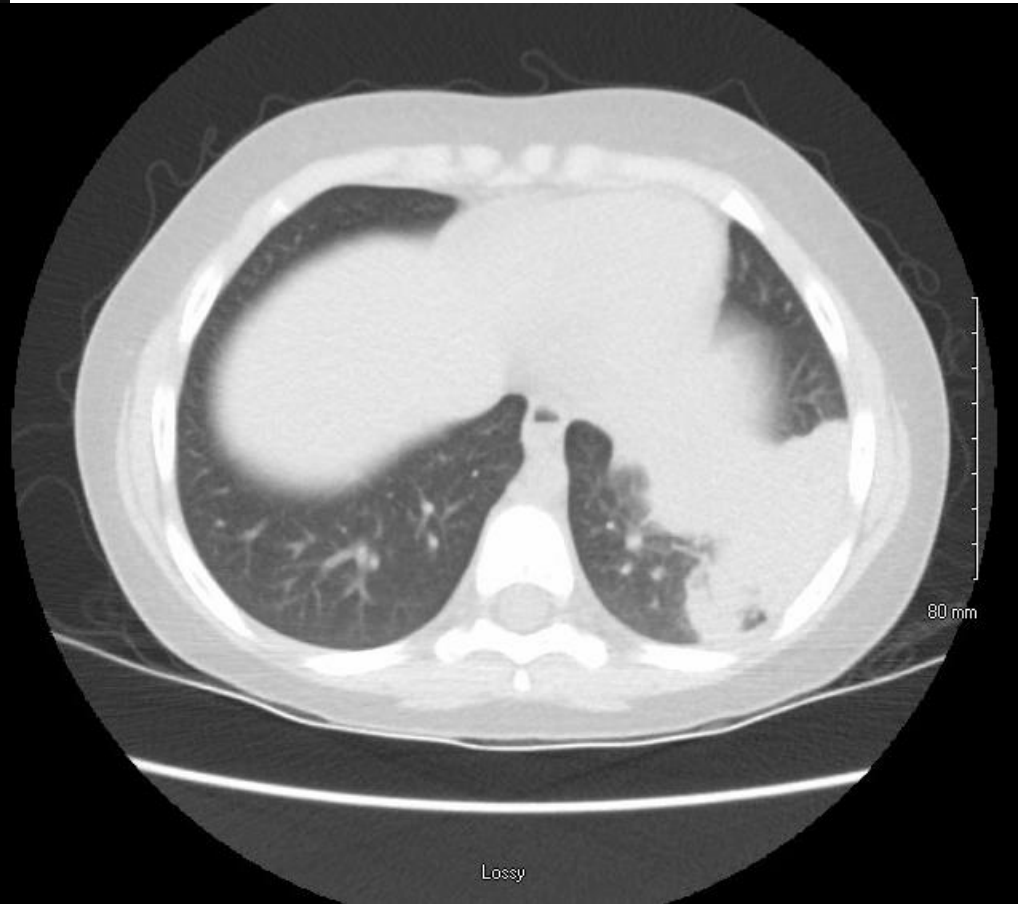
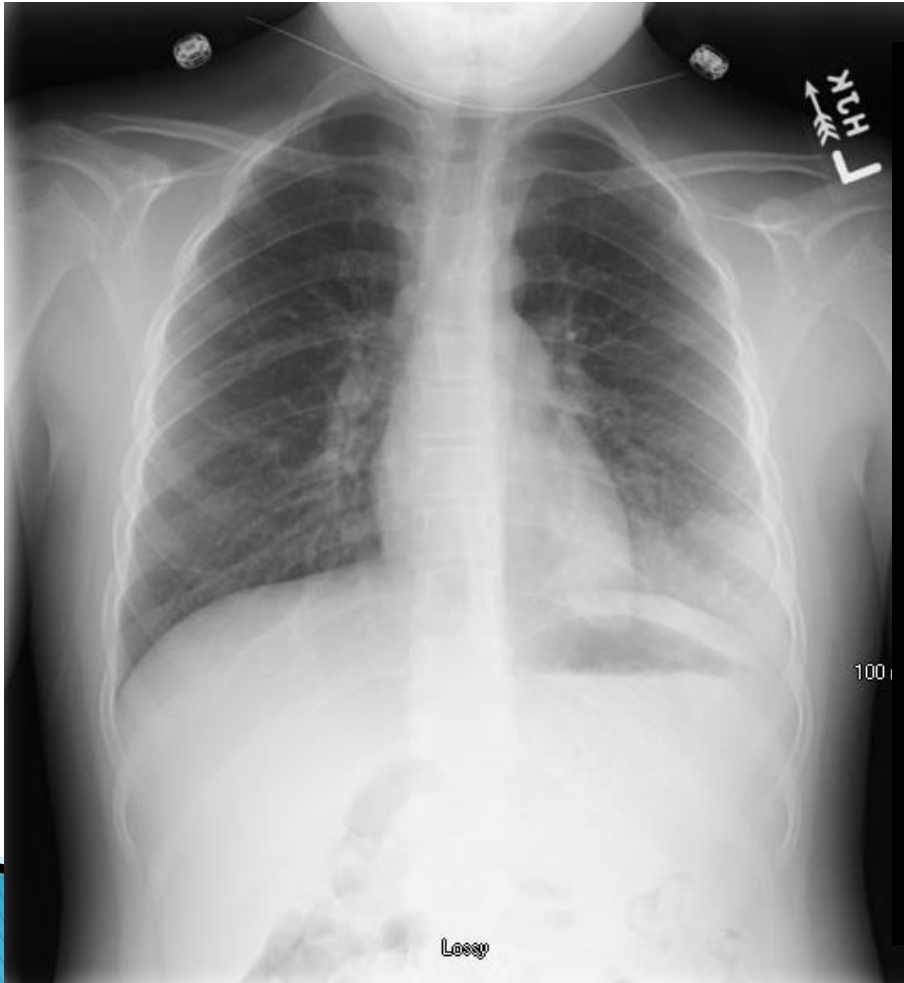
- ▶ 7 year old boy with persistent pneumonia
- ▶ Seen by PCP 1 month earlier with 6 days of cough and nasal congestion.
- ▶ CXR - LLL infiltrate
- ▶ Placed on albuterol and azithromycin
- ▶ No improvement after 5 days >>>cephalexin
- ▶ Fever continued at home
- ▶ Cutaneous pustules
- ▶ Admitted to local hospital IV ceftriaxone for 5 days
- ▶ Fever continued>>>AFCH

Case 5

- ▶ PMH: Shigella enteritis 3 months earlier after trip to Mexico (during WI outbreak)
- ▶ Social HX/ Exposures
 - Born in WI, lives in WI
 - Travel to Mexico x 4
 - No known raw dairy consumption
 - Dogs/cats/cows in Mexico
 - Parents immigrants
 - No know TB exposure

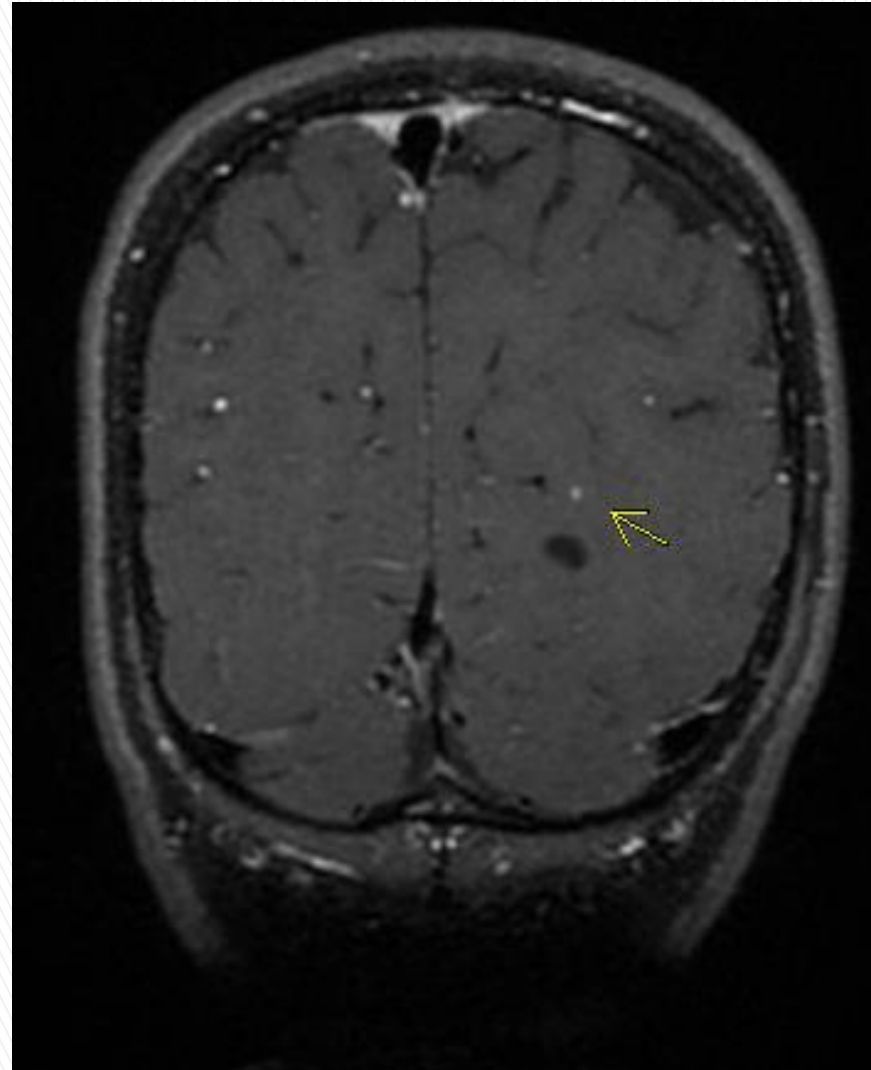
Case 5

- ▶ Fever continued despite vanco + ceftriaxone



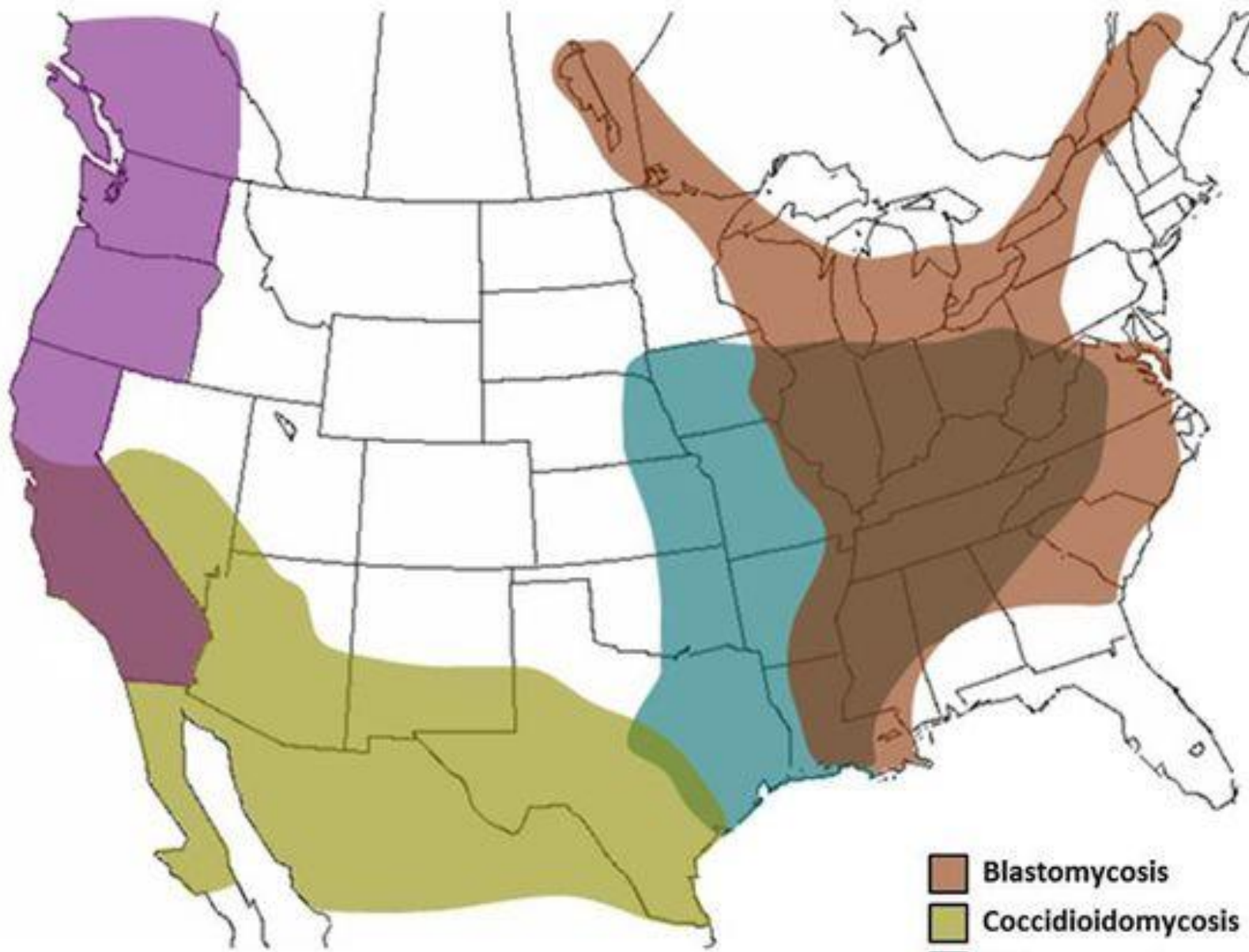
Case 5





- ▶ Developed headache
- ▶ MRI numerous cerebral and cerebellar lesions c/w miliary disease



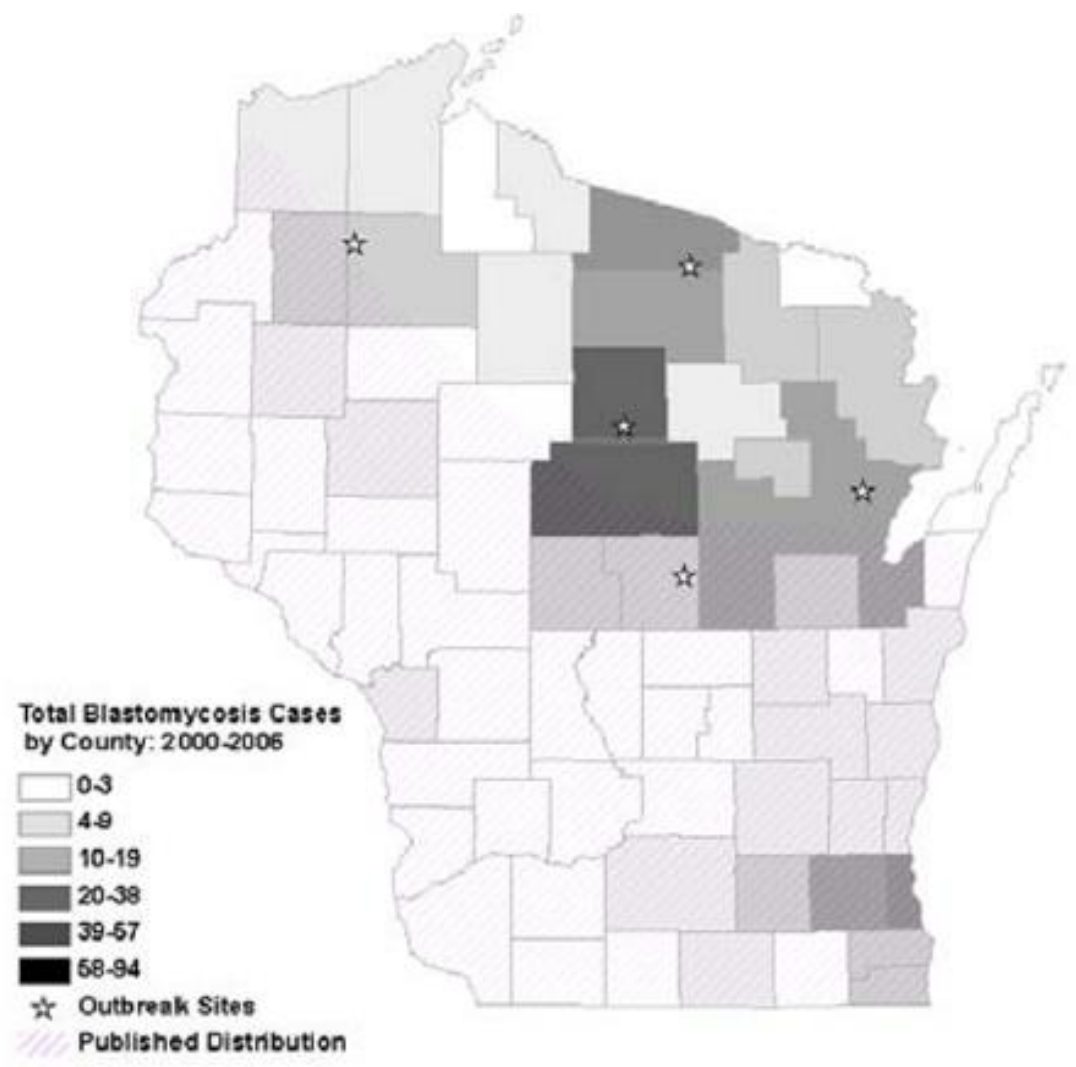
Case 5

- ▶ CSF
 - 1 Nucleated cell
 - Normal glucose and protein
 - Blastomyces antigen negative
- ▶ Serum
 - Quantiferon gold – negative
 - **Blastomyces antigen – positive**
 - Histoplasma antigen – negative
- ▶ Urine
 - **Blastomyces antigen – positive**
 - Histoplasma antigen – negative
- ▶ BAL Culture – *Blastomyces dermatitidis* day 21



-  Blastomycosis
-  Coccidioidomycosis
-  Histoplasmosis
-  *Cryptococcus gattii*

A





Blastomycosis

- ▶ Persistent infiltrate despite anti-bacterials
- ▶ Fever
- ▶ Chills/shakes/night sweats
- ▶ Skin lesions
- ▶ Bone / osteomyelitis
- ▶ CNS disease
- ▶ Increased risk in immunocompromised
- ▶ Increased risk in WI Hmong population*
- ▶ Distinguish from TB / Histoplasmosis

*([Clin Infect Dis.](#) 2013 Sep;)

Blastomycosis

▶ Diagnosis

- Antigen tests
 - Serum
 - CSF
 - Urine
- Antibody test
 - Serum
- Culture
 - Fungal media

▶ Treatment

- Amphotericin liposomal – severe disease
- Itraconazole
- Duration 6–12 months

Emerging pathogens / vectors – WI

▶ Pathogens

- Powassan virus – deer tick– encephalitis
- *Borrelia mayonii* – deer tick – Lyme like illness
- *Borrelia miyamotoi* – deer tick – relapsing fever
- Jamestown Canyon virus – deer/mosquitos

▶ Vectors

- Lone star tick
 - Ehrlichia chafeensis
 - Ehrlichia ewingii
 - Tularemia
 - Southern Tick–associated Rash Illness (STARI)
- *Aedes albopictus* – tiger mosquito
 - zika virus
 - dengue virus
 - chikungunya virus

Amblyomma americanum

Lone Star tick

Diseases

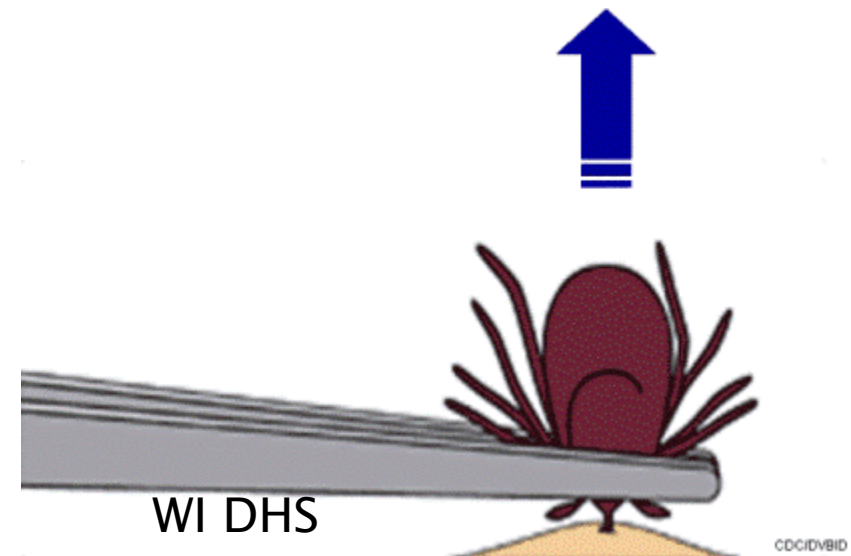
- ▶ Ehrlichia
- ▶ Heartland virus
- ▶ STARI
- ▶ *Francisella tularensis*



Source: Dr. Alana Sterkel WSLH and Tick Encounter Resource center CDC

Prevention

- ▶ Avoid woody areas with tall grass
- ▶ Long pants tucked into socks
- ▶ Long sleeves
- ▶ 20–30 % DEET
- ▶ Tick checks and removal
- ▶ Permethrin on clothing
- ▶ Mosquito /tick abatement





The Wisconsin State microbe is?:

- A. *Saccharomyces cerevisiae*
- B. *Lactobacillus casei*
- C. *Lactococcus lactis*
- D. *Borellia burgdorferi*

Wisconsin Becomes First State to Name Official Microbe, Honoring Cheese-Producing Bacterium

Only 49 to go

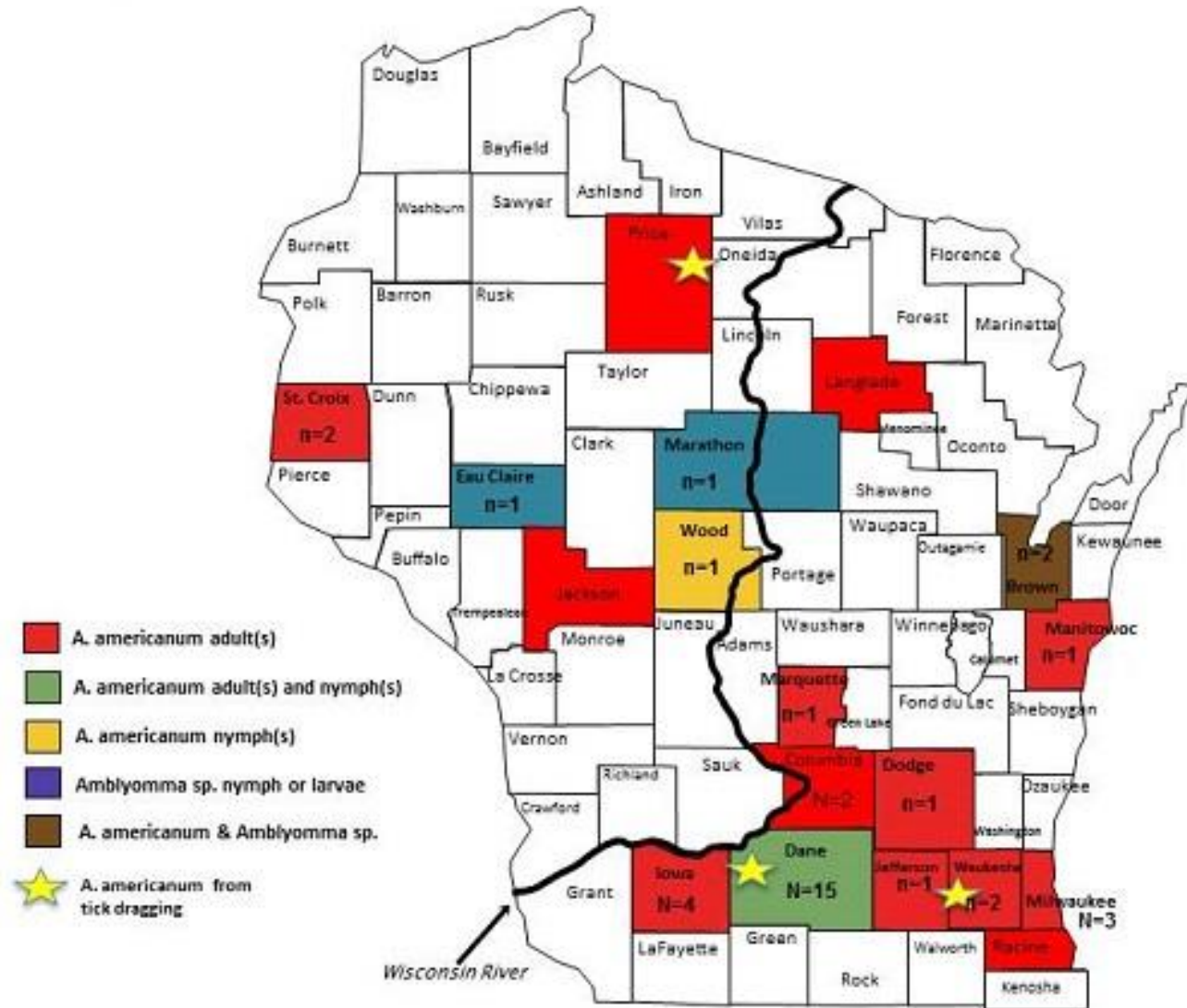
By Jeremy Hsu Posted 04.19.2010 at 1:14 pm 1 Comment



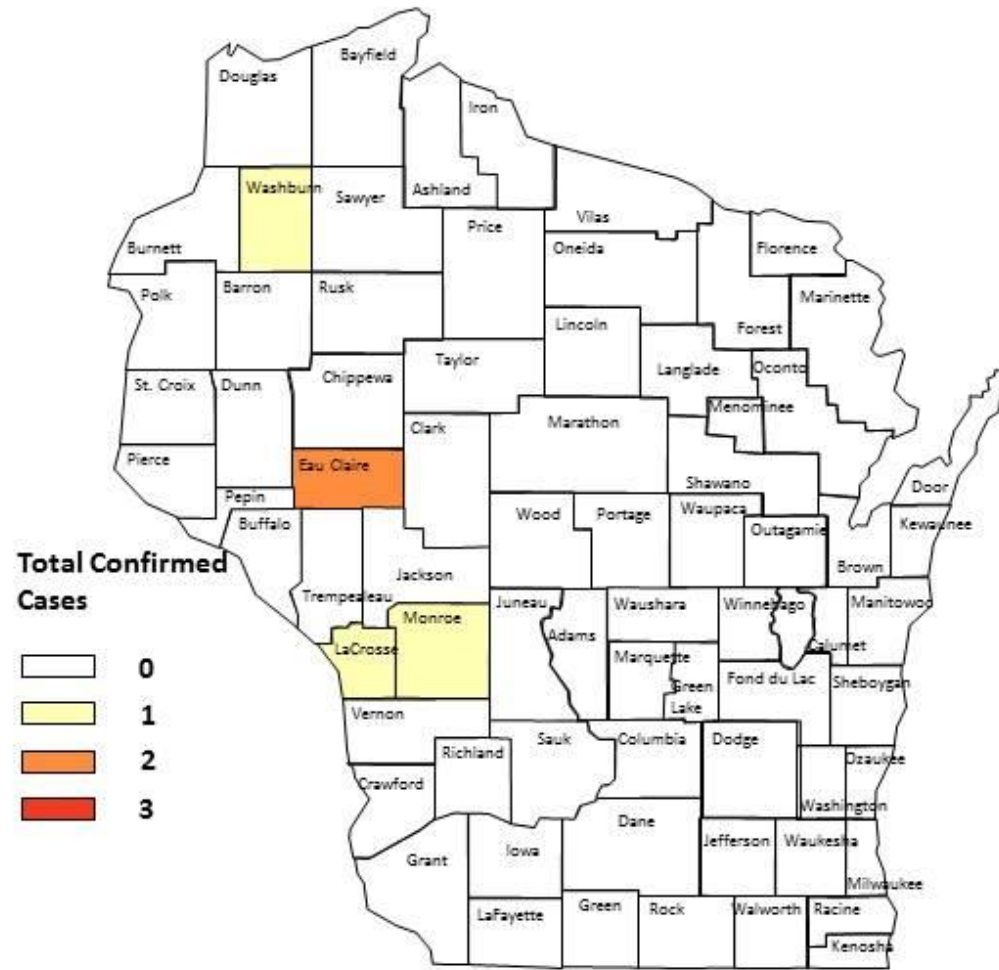
Cheddar Cheese Even the lactose intolerant have to respect the cheese *Pacific Northwest Cheese Project*

It's good to know that Wisconsin state legislators can overcome partisan divisions and a host of pressing issues to jointly select an official state microbe – the *Lactococcus lactis* bacterium responsible for helping make delicious cheddar, Colby and Monterey Jack cheese. That makes Wisconsin the first U.S. state to bestow such an honor upon a microbe, the *New York Times* reports.

Amblyomma americanum records in Wisconsin 2006-2013



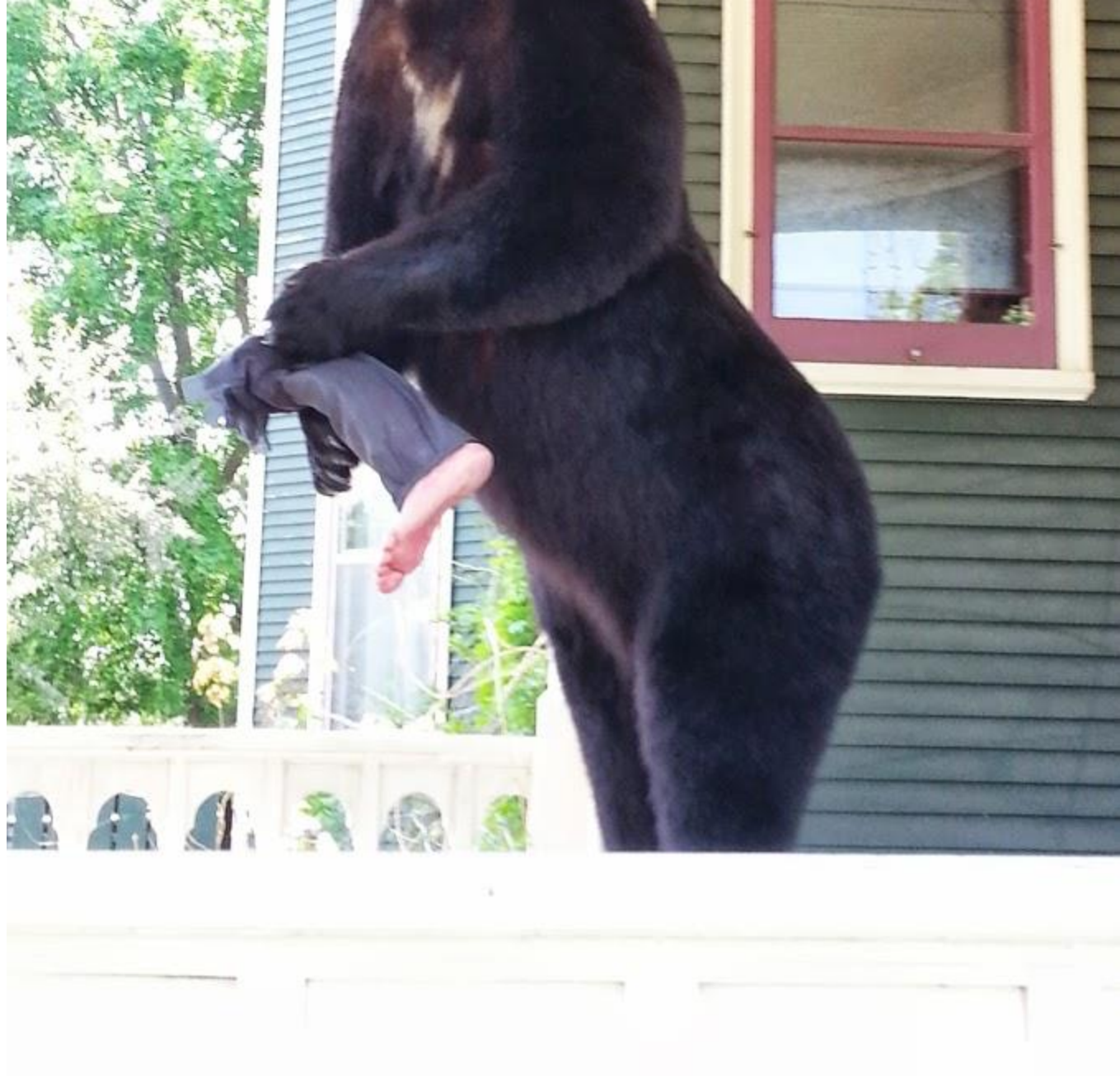
Wisconsin Lyme Disease (*Borrelia mayonii*) Total Confirmed Cases 2013 – 2016 (n=5)



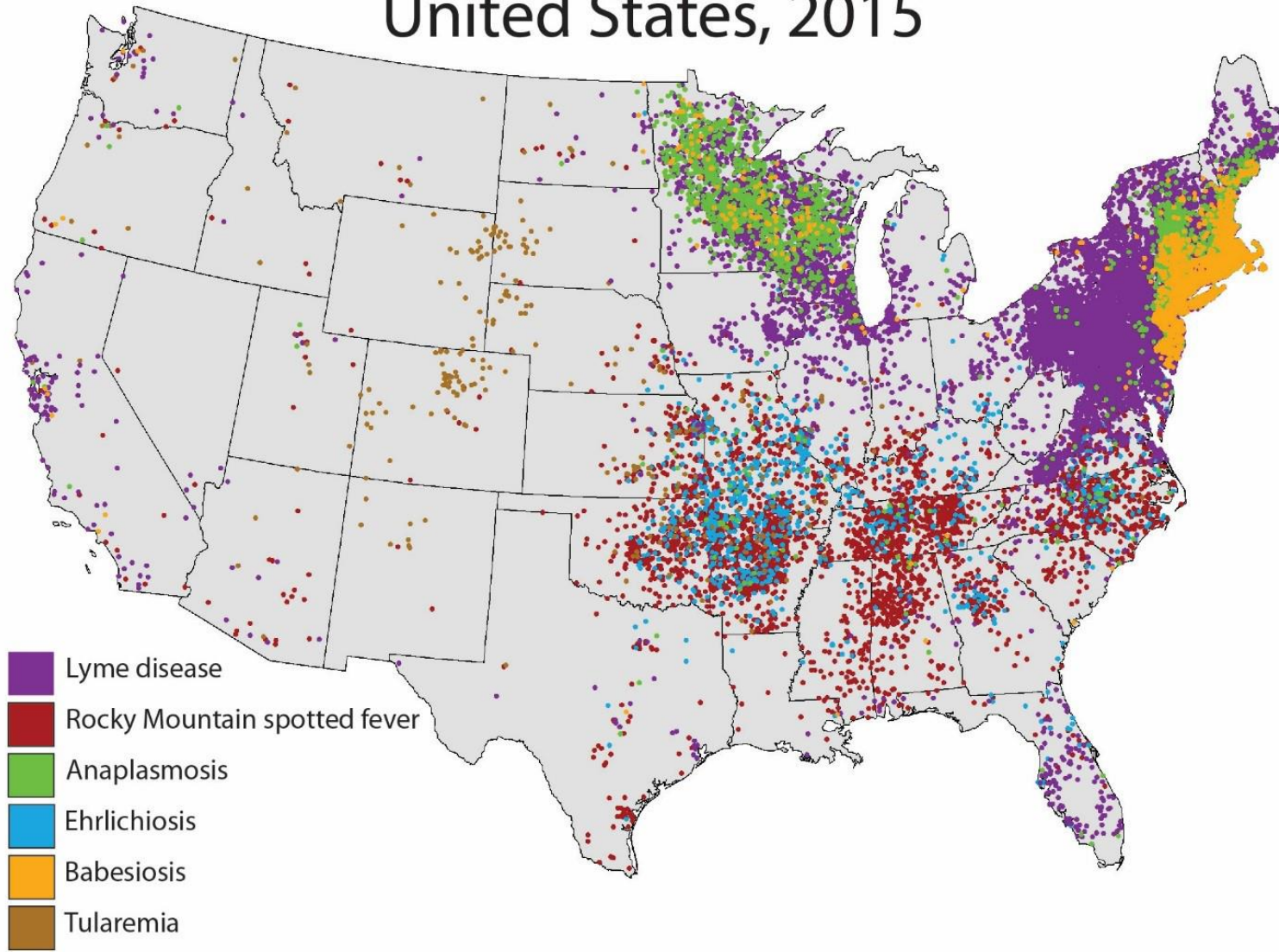
This map is based on the county of residence of confirmed cases. Some infections may have been acquired during travel to other areas.

- ▶ Lyme
- ▶ Babesia
- ▶ Anaplasma/ehrlichia
- ▶ La crosse
- ▶ Blasto
- ▶ WNV
- ▶ Zika?
- ▶ Historical
- ▶ Histo
- ▶ RMSF
- ▶ Powassan
- ▶ Borrelia myomota





Distribution of Key Tickborne Diseases, United States, 2015



NOTE: Each dot represents one case. Cases are reported from the infected person's county of residence, not necessarily the place where they were infected.


ADD?

- ▶ TICK ID

Which of the following are dimorphic fungi that are endemic to Wisconsin?

- ▶ A) *Blastomyces dermatitidis*
- ▶ B) *Coccidioides immitis*
- ▶ C) *Histoplasma capsulatum*
- ▶ D) *Blastocystis hominis*

Which of the following are arthropod borne infections in which both the vector and the virus are endemic to Wisconsin?

- ▶ A) LaCrosse virus
 - ▶ B) Dengue virus
 - ▶ C) Zika virus
 - ▶ D) West Nile virus
- 

Prolonged or repeated course of antibiotics for Lyme disease:

- ▶ A) are routinely recommended by the IDSA for difficult cases.
 - ▶ B) should only be prescribed by Lyme literate physicians.
 - ▶ C) have resulted in deep venous thromboses, central line associated blood stream infections, *C. difficile* colitis and death.
 - ▶ D) should be given if the patient responds to a course of antibiotics.
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