



Tick-Borne Diseases

Dutchess County, New York

Overview

Geographic distribution of tick-borne disease in the United States

Tick-borne disease in Dutchess County, NY

Recently recognized tick-borne diseases

Infectious Tick-borne Diseases in the United States

Endemic to Dutchess County, NY

- Lyme disease (borreliosis)
- Anaplasmosis
- Babesiosis
- Ehrlichiosis
- Powassan disease
- Rocky Mountain Spotted Fever
- Tularemia
- *Borrelia miyamotoi* *

Endemic in other parts of the USA

- Colorado tick fever
- Southern tick-associated rash illness (STARI)
- Tickborne relapsing fever
- *Rickettsia parkeri* rickettsiosis
- 364D rickettsiosis
- Heartland virus
- *Borrelia mayonii*



Tick Paralysis

Non-infectious Tick-Borne
Syndrome



Tick Paralysis Symptoms

2- 7 days after attachment

Acute, ascending flaccid paralysis
that is confused with other
neurologic disorders

The condition can worsen to
respiratory failure and death in
about (10%) of the cases

Pathogenesis of Tick Paralysis

Tick paralysis is chemically induced by the tick and therefore usually only continues in its presence.

Once the tick is removed, symptoms usually diminish rapidly.

However, in some cases, profound paralysis can develop and even become fatal before anyone becomes aware of a tick's presence



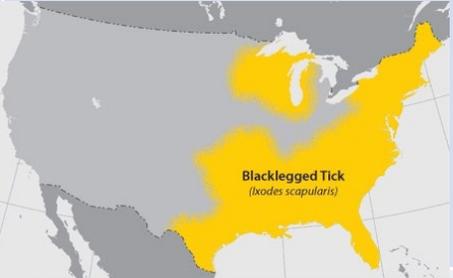
Only 2 Human Cases Reported in Dutchess County Since 1995

Ticks that cause tick paralysis are found in almost every region of the world. In the United States, most reported cases have occurred in the Rocky Mountain states, the Pacific Northwest and parts of the South.

The five North American species of ticks thought to cause tick paralysis are widely distributed throughout the United States; therefore, the potential for contact with such ticks exists in every state



Ticks that Transmit Disease in Dutchess County, NY

Tick	Female	Male	Geographic Distribution	Possible Pathogens they carry
Black-legged Tick nickname: Deer Tick <i>Ixodes scapularis</i>				Lyme disease Anaplasmosis Babesiosis <i>Borrelia miyamotoi</i> Powassan disease (Deer tick virus) Tick paralysis
American Dog Tick <i>Dermacentor variabilis</i>				Rocky Mountain Spotted Fever Tularemia Tick Paralysis
Lone Star Tick <i>Amblyomma americanum</i>				Ehrlichiosis STARI Tularemia Heartland virus? Tick paralysis
Woodchuck Tick <i>Ixodes cookei</i>				Powassan disease* * <i>I. cookei</i> carries POW virus, but rarely bites humans



Asian Longhorn Tick

A New Tick-Borne Disease Threat?



Asian Longhorned Tick What You Need To Know

- Not normally found in the Western Hemisphere, these ticks were reported for the first time in the United States in 2017.
- Asian longhorned ticks have been found on pets, livestock, wildlife, and people.
- The female ticks can lay eggs and reproduce without mating.
- Up to thousands of ticks may be found at a time, or on an animal.

Where have they been found?



Figure 1. Known U.S. distribution of *Haemaphysalis longicornis* (as of August 30, 2018).

The species was not known to be present on the mainland United States until November 9, 2017, when it was first discovered on a sheep farm in Hunterdon County, New Jersey



Threats to Livestock

The longhorned tick can transmit an animal disease called theileriosis to cattle, which can cause considerable blood loss and occasional death of calves, but mainly is important to dairy farmers because of decreased milk production and sheep farmers because of decreased wool quantity and quality

Diseases in Humans

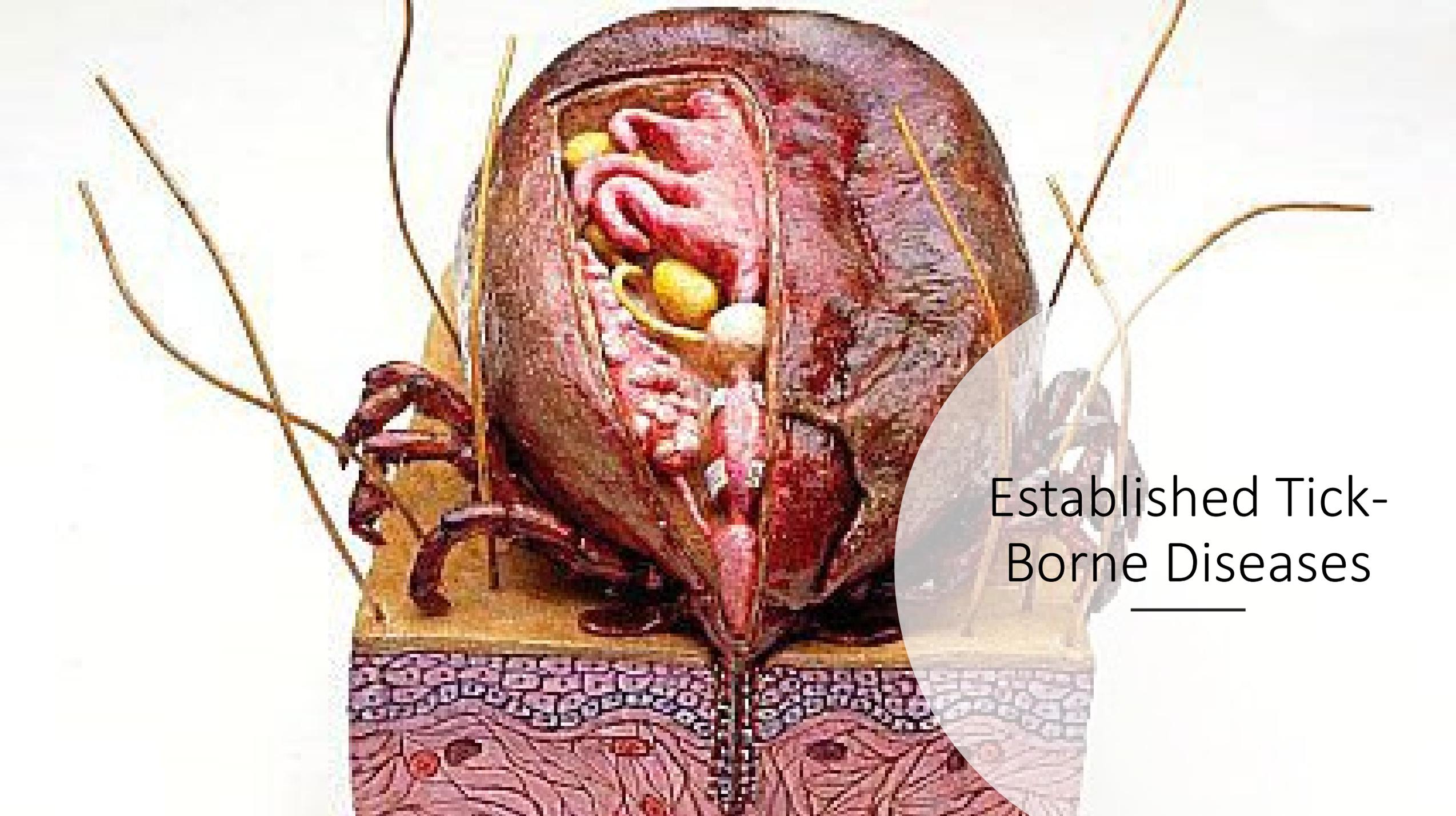
- It has been associated with
 - Russian spring-summer encephalitis
 - Powassan virus
 - Khasan virus
 - Tick-borne encephalitis virus
 - Japanese spotted fever
 - Severe fever/thrombocytopenia syndrome.
- Human diseases such as Lyme spirochetes, spotted fever group rickettsiae, *Ehrlichia chaffeensis*, and *Anaplasma bovis* have been detected in *H. longicornis*.



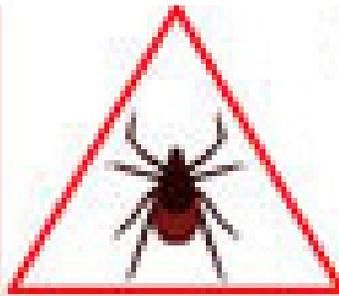
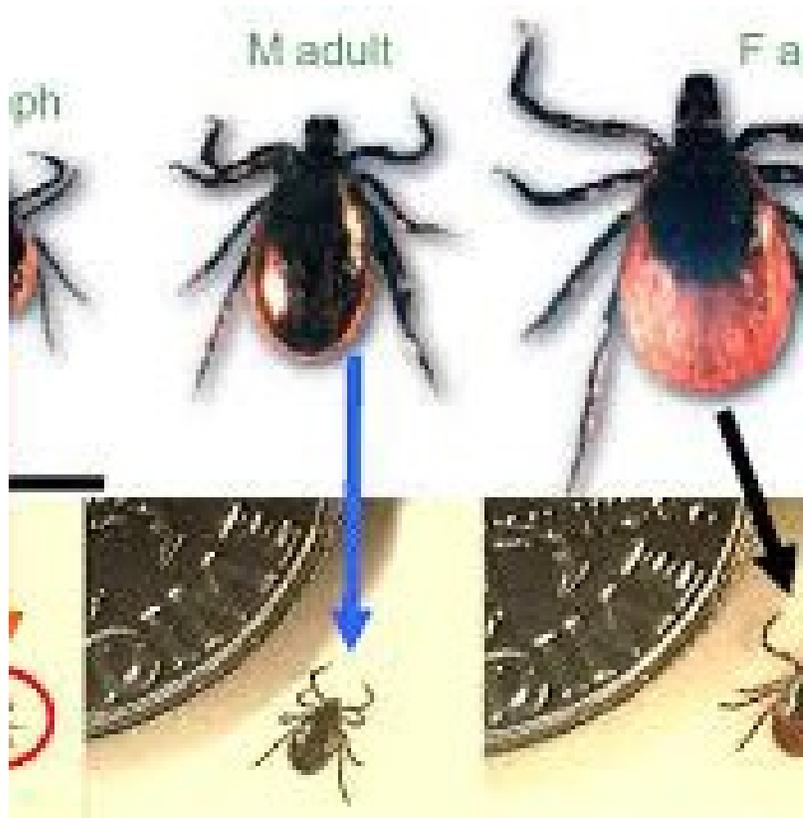


Can this tick
transmit
pathogens to
humans

Human pathogens have not so far
been detected in the long- horned
tick in the US

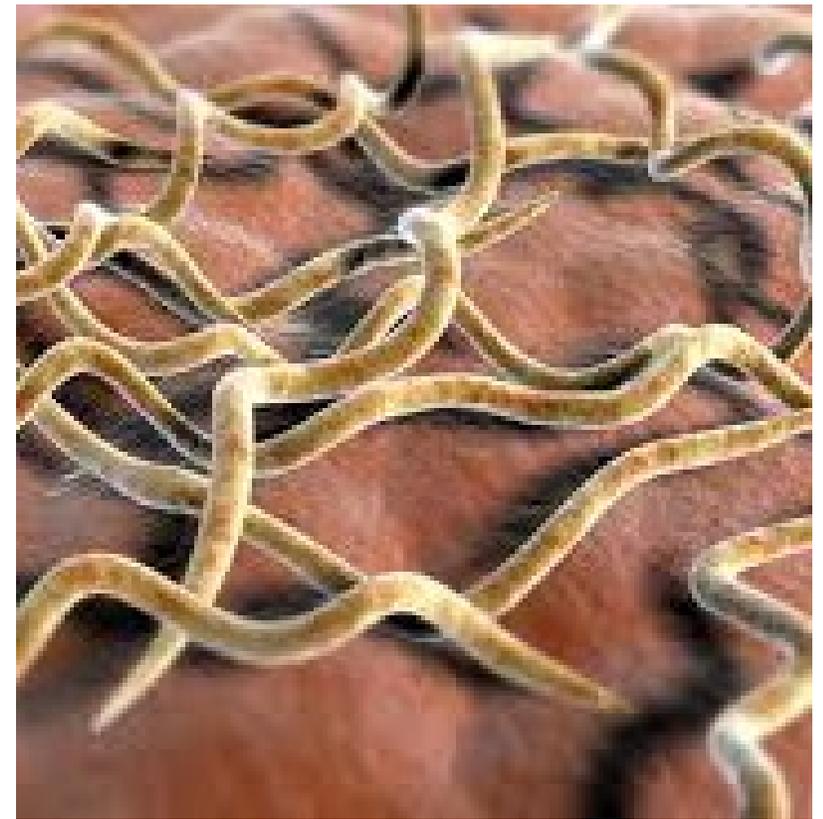


Established Tick-
Borne Diseases



PREVENT LYME DISEASE!

- WEAR REPELLENT
- CHECK FOR TICKS DAILY
- SHOWER SOON AFTER BEING OUTDOORS
- CALL YOUR DOCTOR IF YOU GET A FEVER OR RASH



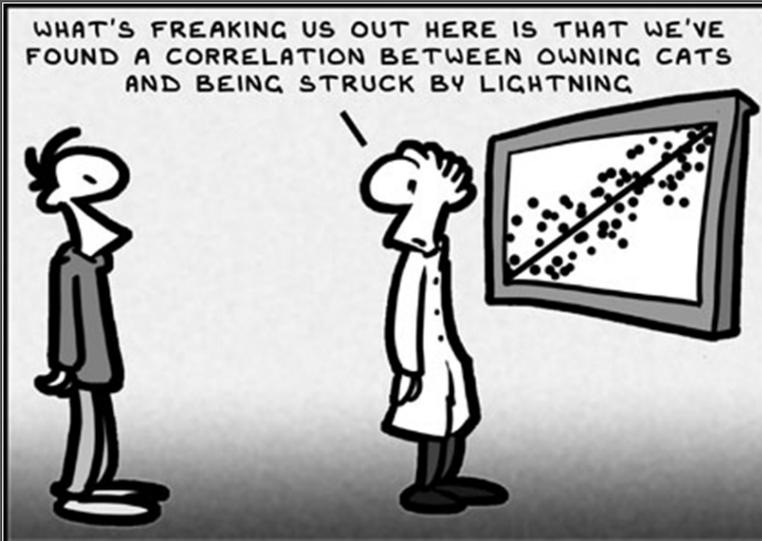
Lyme disease



Lyme Disease Surveillance Data

Lyme disease has been a nationally notifiable condition in the United States since 1991. Reports of Lyme disease are collected and verified by state and local health departments in accordance with their legal mandate and surveillance practices.

Limitations to Lyme Disease Surveillance



1. Under-reporting and misclassification are features common to all surveillance systems. Not every case of Lyme disease is reported to CDC, and some cases that are reported may be due to another cause. Under-reporting is more likely to occur in highly endemic areas, whereas over-reporting is more likely to occur in non-endemic areas.

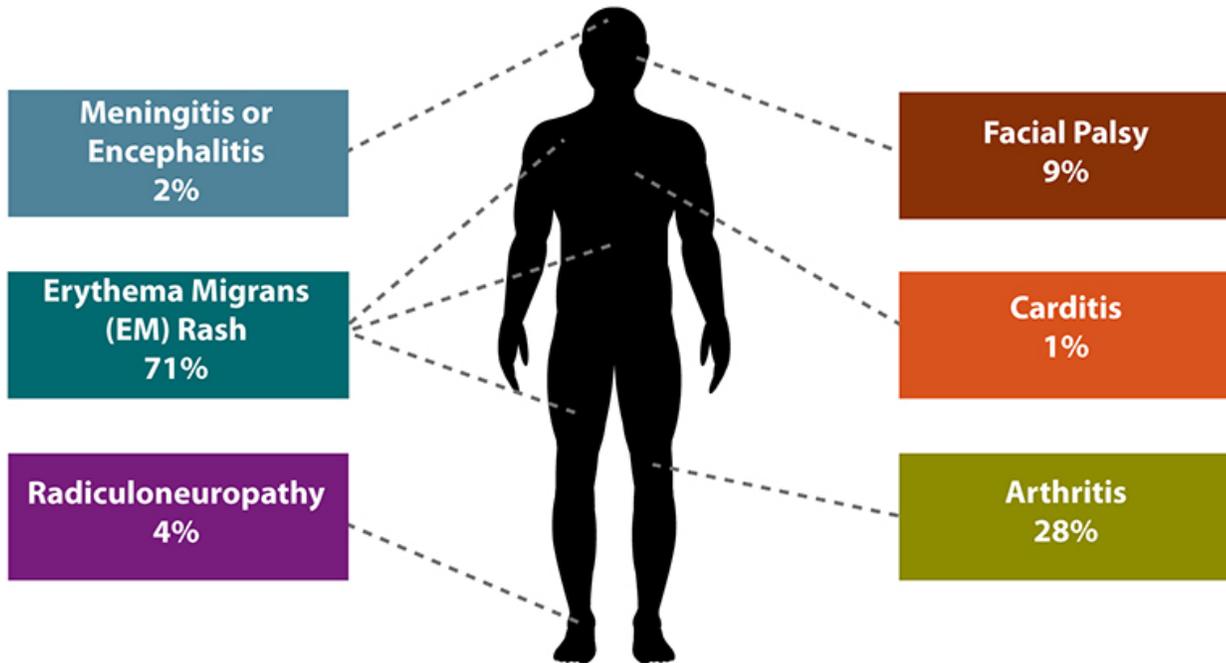
2. Surveillance data are subject to each state's abilities to capture and classify cases, which are dependent upon budget and personnel and varies not only between states, but also from year to year within a given state. Consequently, a sudden or marked change in reported cases does not necessarily represent a true change in disease incidence, and should not be construed as such without knowledge of that state's historical surveillance practices.

3. Surveillance data are captured by county of residence, not county of exposure.

4. States may close their annual surveillance dataset at a different time than CDC. Thus, the final case counts published by CDC may not exactly match numbers published by each state agency for a given year.

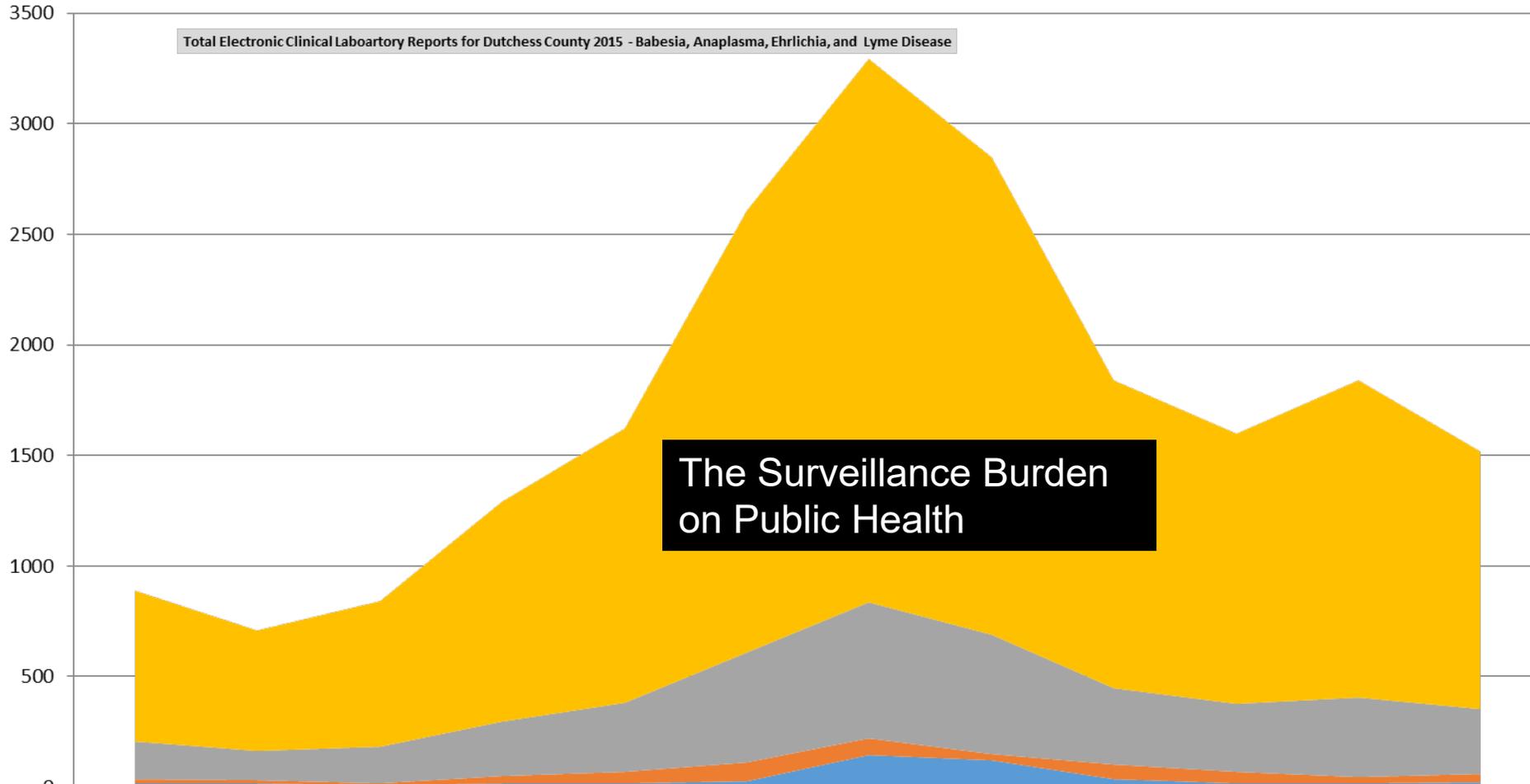
5. Following its implementation in 1991, the national surveillance case definition for Lyme disease was modified in 1996, 2008, 2011, and again in 2017. Changes were generally minor but may have had some impact on surveillance and must be considered when attempting to interpret trends. Case definitions for each period are available.

Lyme disease - Relative frequency of clinical features among confirmed cases - United States, 2008 - 2017



Clinical Manifestations of Confirmed Lyme Disease Cases-- United States, 2008 to 2017

Total NUMBER of CLRS Reports Received



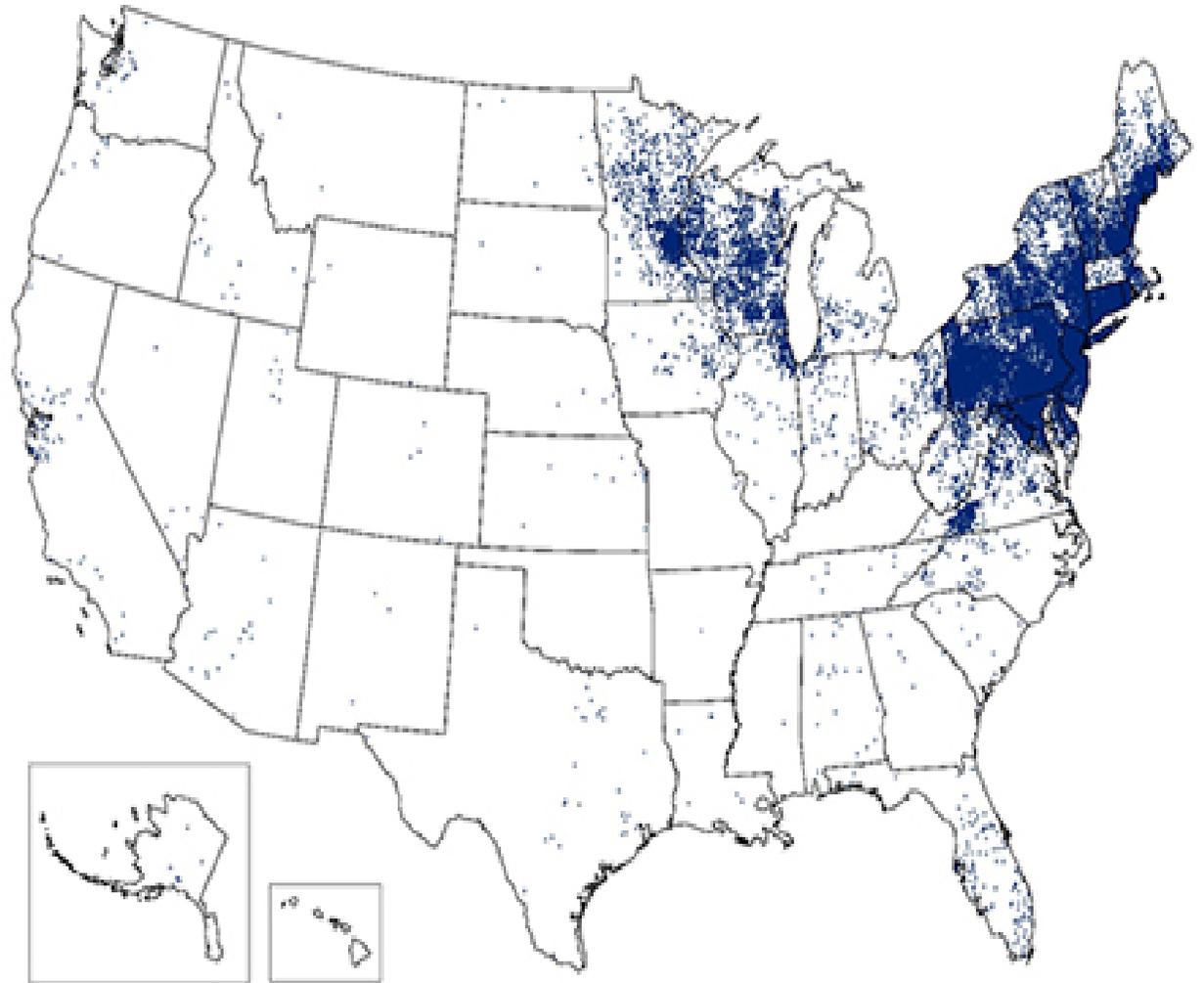
- *Lyme 80%
- Lyme 20%
- Ana/Eh
- Babesia

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
*Lyme 80%	680	544	656	992	1240	1996	2460	2156	1388	1224	1436	1168
Lyme 20%	170	136	164	248	310	499	615	539	347	306	359	292
Ana/Eh	22	11	13	32	54	84	76	30	69	51	30	39
Babesia	16	18	6	18	17	26	143	121	34	18	15	20

Lyme disease

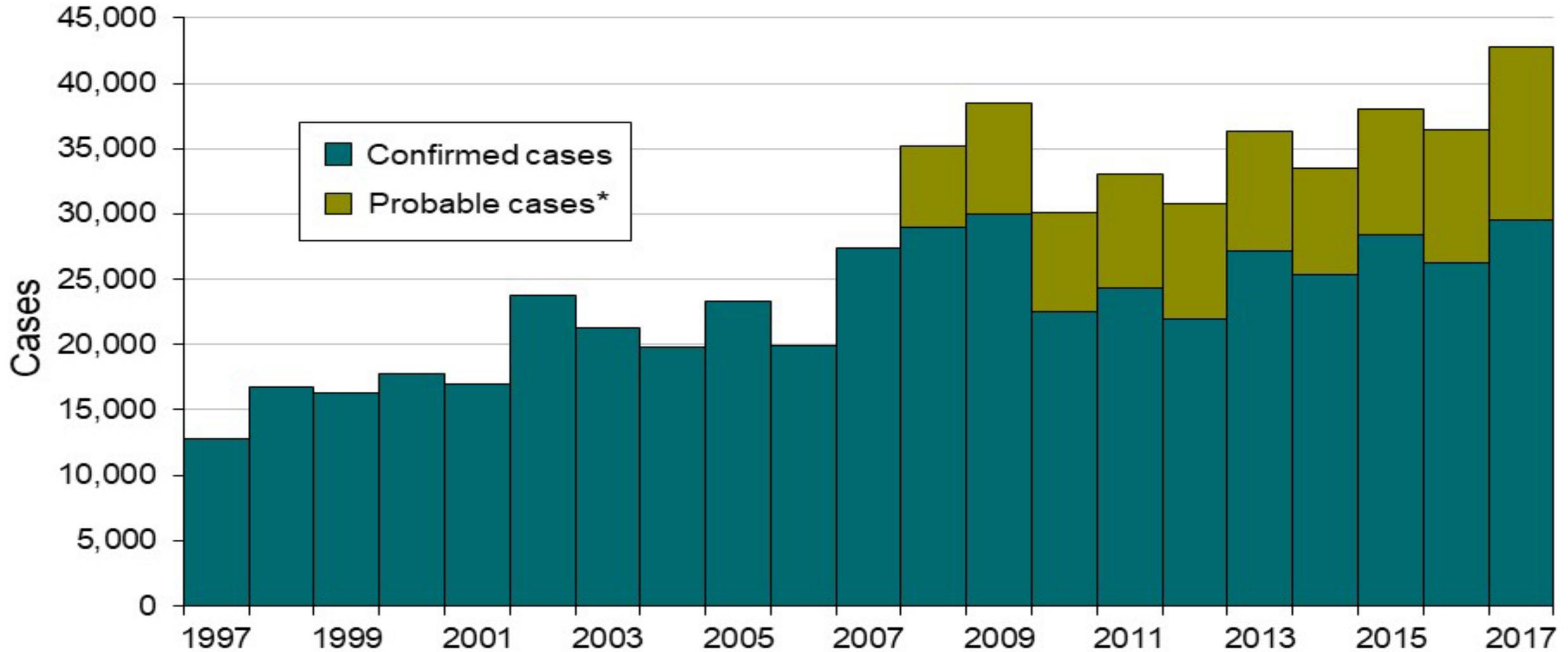
Each year, approximately 30,000 cases of Lyme disease are reported to CDC by state health departments and the District of Columbia. However, this number does not reflect every case of Lyme disease that is diagnosed in the United States every year.

Standard national surveillance is only one way that public health officials can track where a disease is occurring and with what frequency. Recent estimates using other methods suggest that approximately 300,000 people may get Lyme disease each year in the United States.



1 dot placed randomly within county of residence for each confirmed case

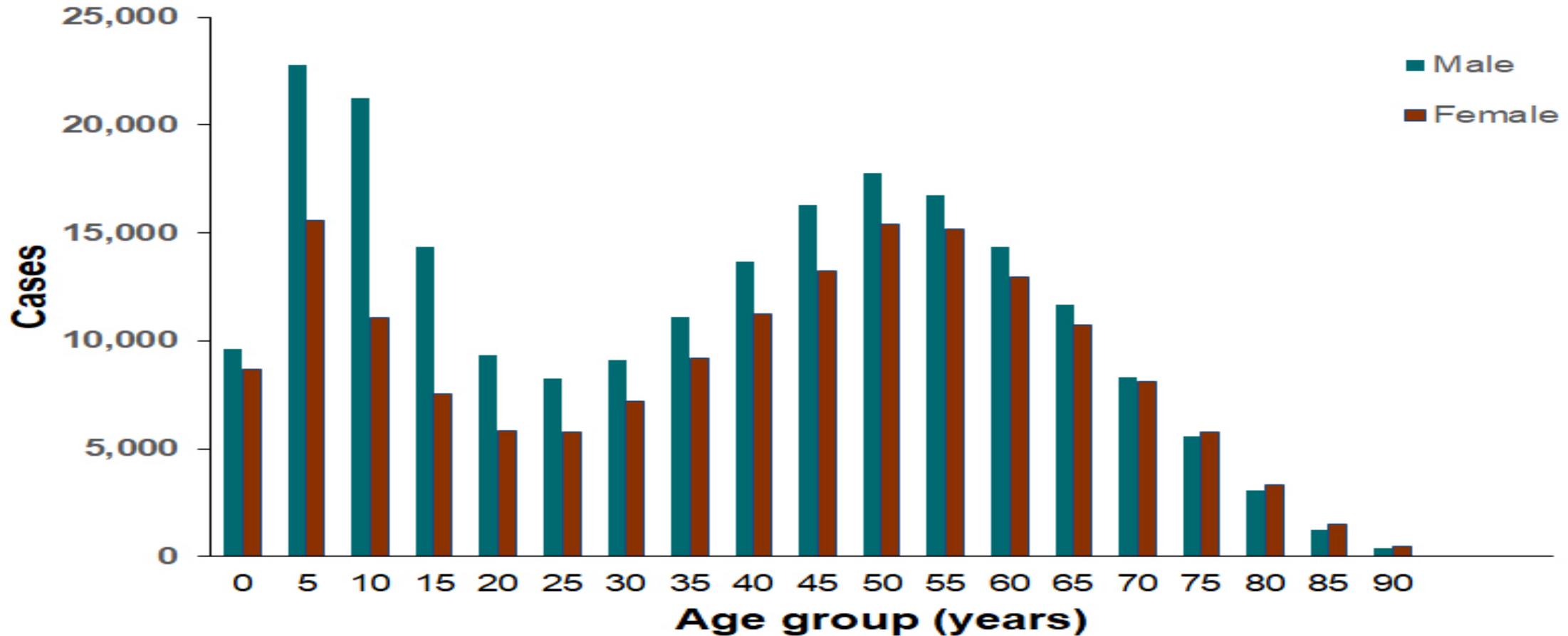
Reported Cases of Lyme Disease by Year, United States, 1995-2017



Source: Centers for Disease Control and Prevention Lyme Disease Statistics

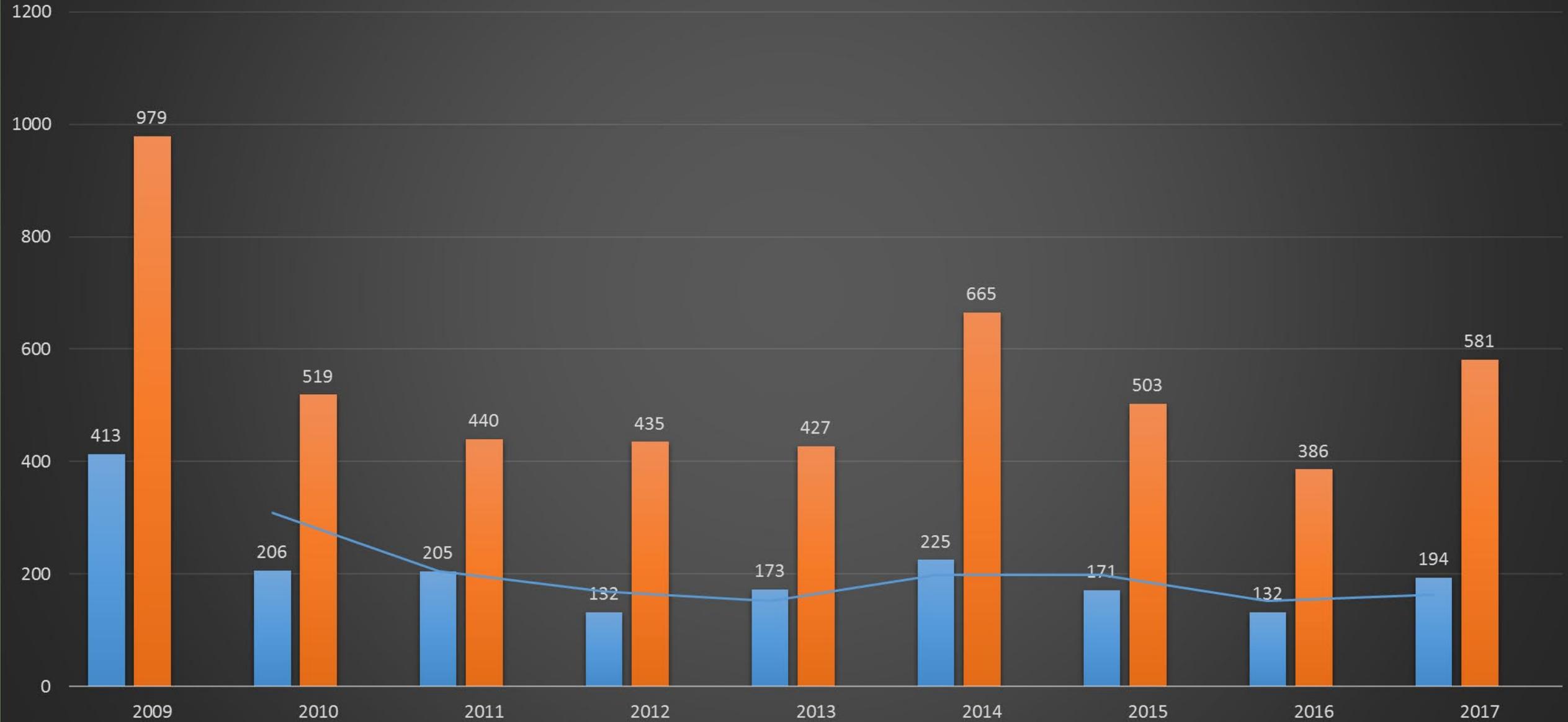
Lyme disease cases by age and sex--United States, 2001- 2017

Confirmed Lyme disease cases by age and sex--United States, 2001-2017



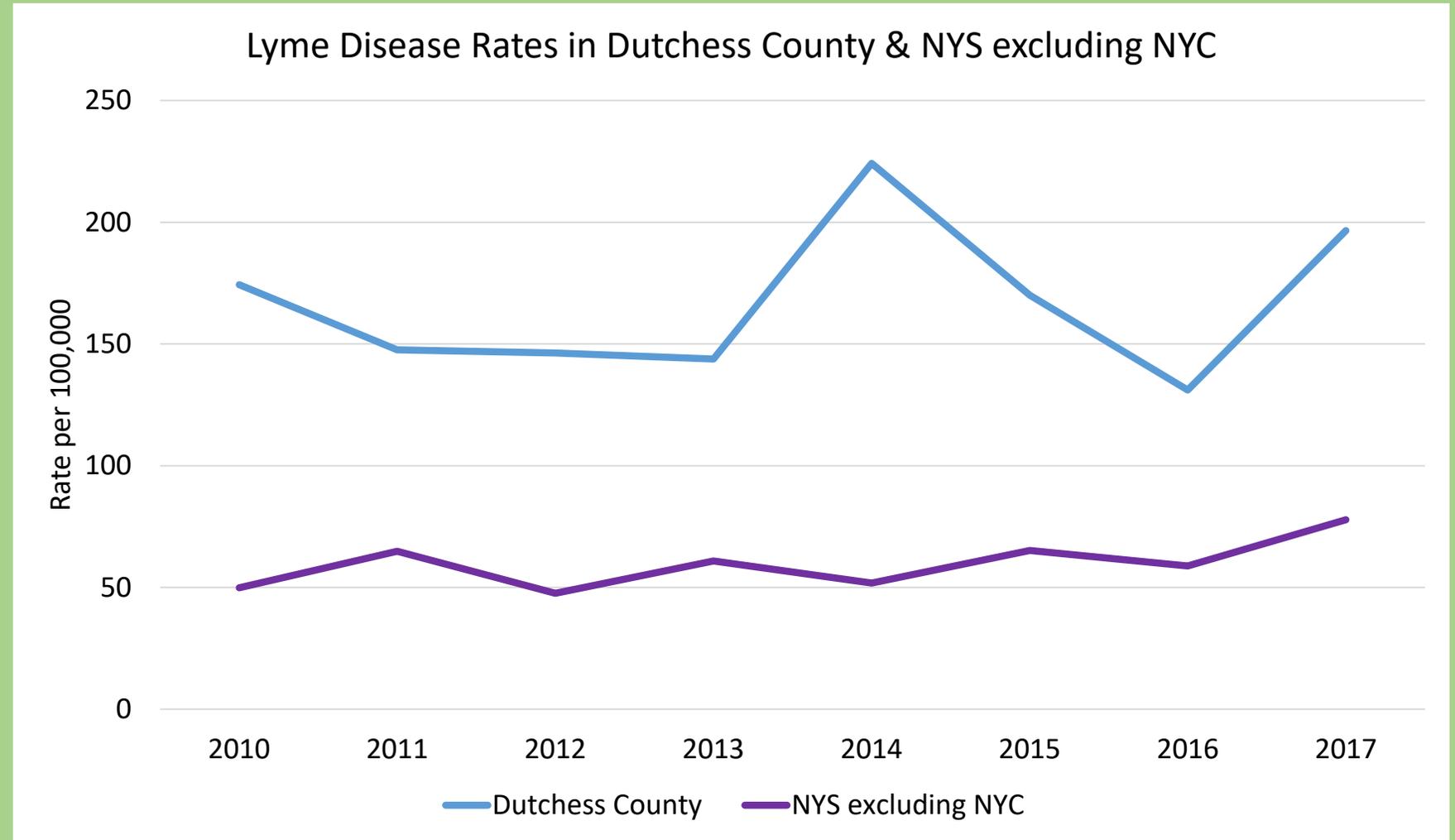
Reported and Corrected Lyme Disease Dutchess County 2009-2017

20% Projected Numbers 2 per. Mov. Avg. (20%)



Estimated incidence of Lyme Disease NYS & Dutchess County, NY 2010-2017

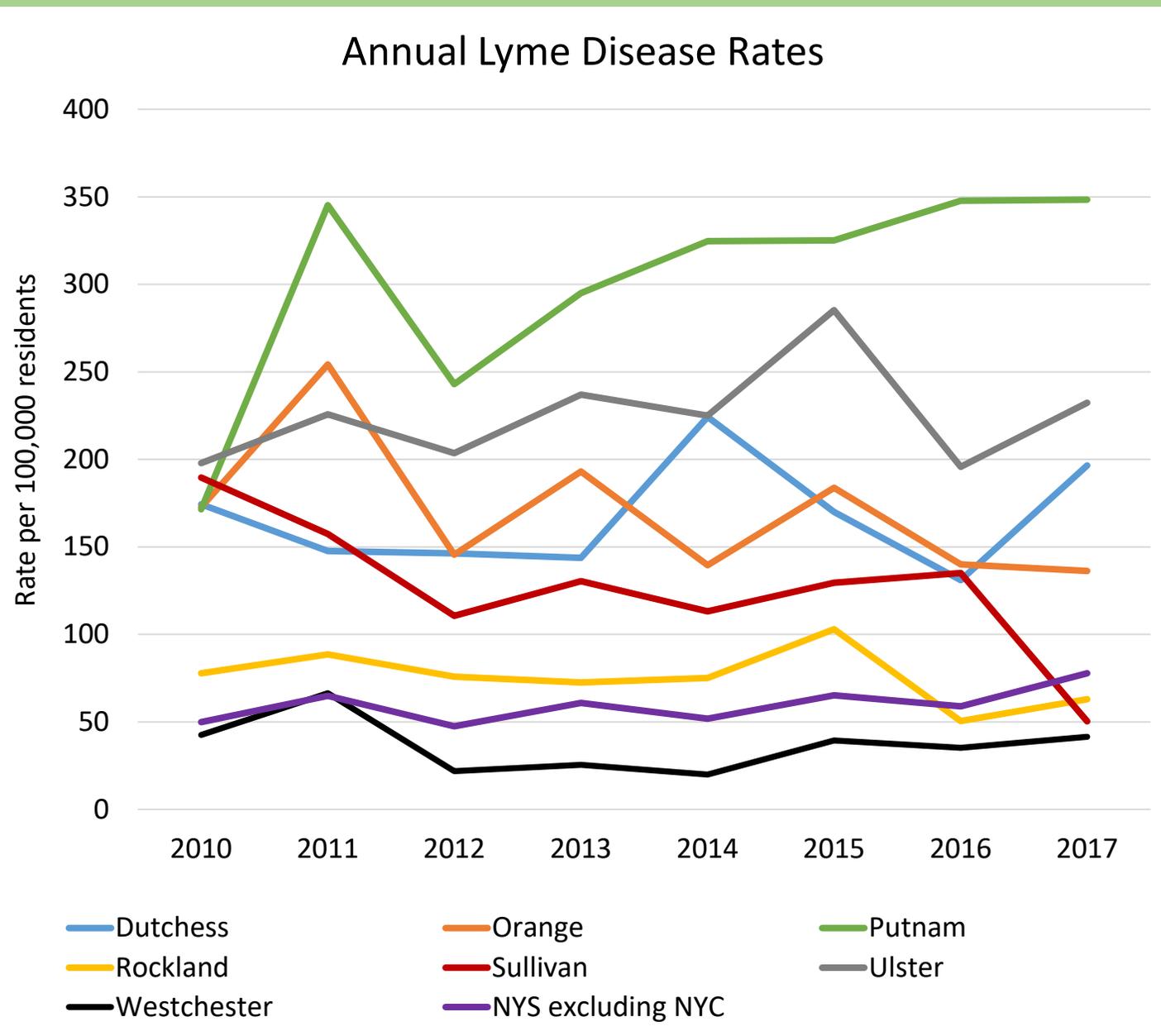
There were an estimated 581 cases of Lyme disease in Dutchess County in 2017.



Note: In 2009, Dutchess County became a sentinel surveillance county; annual numbers are estimated by the New York State Department of Health.

Data Source: New York State Department of Health Communicable Disease Registry

Lyme Disease in The Hudson Valley Region



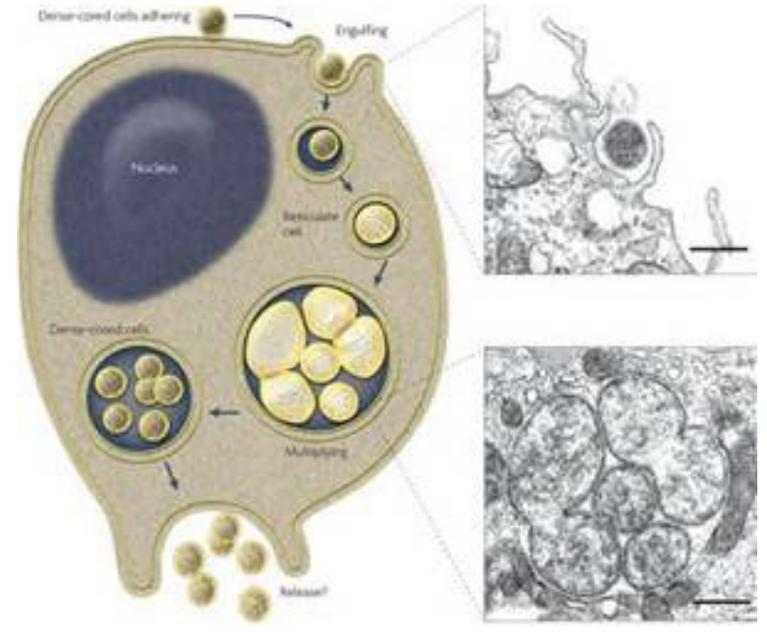
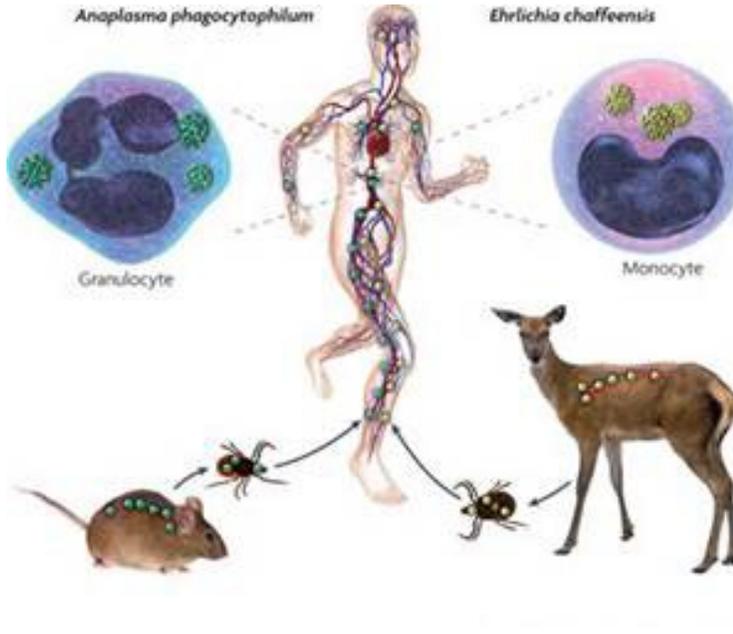
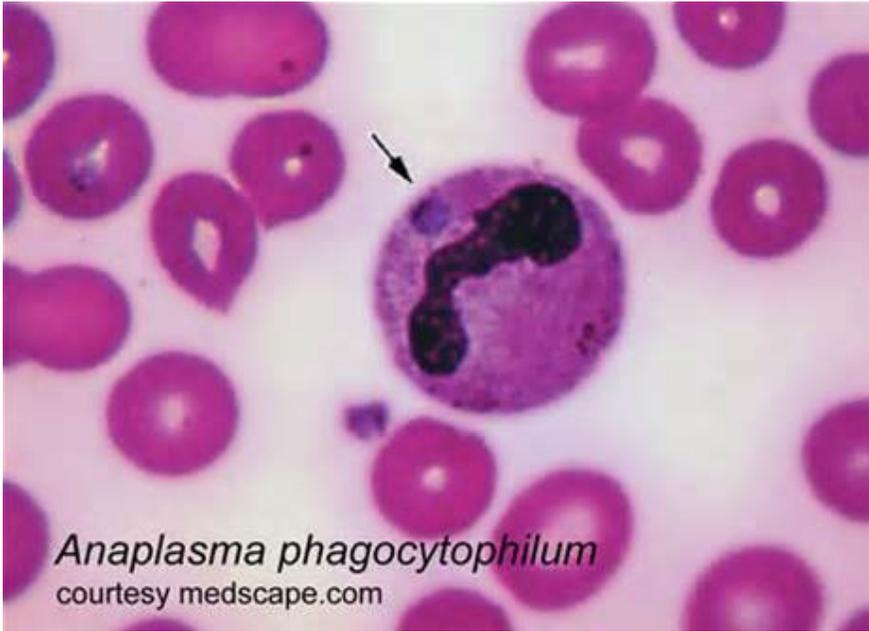
Early Signs and Symptoms (3 to 30 days after tick bite)

- Fever, chills, headache, fatigue, muscle and joint aches, and swollen lymph nodes
- Erythema migrans (EM) rash:
 - Occurs in approximately 70 to 80 percent of infected persons
 - Begins at the site of a tick bite after a delay of 3 to 30 days (average is about 7 days)
 - Expands gradually over a period of days reaching up to 12 inches or more (30 cm) across
 - May feel warm to the touch but is rarely itchy or painful
 - Sometimes clears as it enlarges, resulting in a target or “bull’s-eye” appearance
 - May appear on any area of the body



- Severe headaches and neck stiffness
- Additional EM rashes on other areas of the body
- Arthritis with severe joint pain and swelling, particularly the knees and other large joints.
- Facial palsy (loss of muscle tone or droop on one or both sides of the face)
- Intermittent pain in tendons, muscles, joints, and bones
- Heart palpitations or an irregular heart beat (Lyme carditis)
- Episodes of dizziness or shortness of breath
- Inflammation of the brain and spinal cord
- Nerve pain
- Shooting pains, numbness, or tingling in the hands or feet
- Problems with short-term memory

Later Signs and Symptoms (days to months after tick bite)



Anaplasmosis & Ehrlichiosis

	Human Granulocytic Anaplasmosis	Human Monocytic Ehrlichiosis
Causative Agent	<i>Anaplasma phagocytophilum</i>	<i>Ehrlichia chaffeensis and ewingii and muris-like</i>
Incubation Period	1-30 days (average 7-14 days)	1-30 days (average 7-14 days)
Classic Symptoms	Fever, Headache, Constitutional Symptoms, GI symptoms, Cough, Rash is rare with anaplasmosis	Fever, Headache, Constitutional Symptoms, GI Symptoms, Conjunctival injection, Rash (60% children, 30% adults)
Risk Factors	Increased incidence as age increases	Increased incidence as age increases
Outcomes	Case Fatality rate <1%	Case Fatality Rate of 1.8%
CBC & Chemistry	Thrombocytopenia Leukopenia Elevated Liver Enzymes	Thrombocytopenia Leukopenia Elevated Liver Enzymes
Treatment	Doxycycline	Doxycycline

Lab Detection of Anaplasmosis and Ehrlichiosis

Anaplasmosis

- PCR
 - Sensitive in 1st week after onset.
 - Antibiotics decrease sensitivity
 - Negative result does not rule out
- Smear
 - Morulae in white blood cells in 20% of patients first week after onset
 - *A. phagocytophilum* seen in granulocytes
- Serology: IgG IFA
 - Detectable titer 7-10 days after onset
 - 2 samples 2-4 weeks apart: 4 fold rise in titer
 - IgM rises at same time as IgG, may remain elevated for months, and is less specific (false positives)

Ehrlichiosis

- PCR
 - Sensitive in 1st week after onset.
 - Antibiotics decrease sensitivity
 - Negative result does not rule out
- Smear
 - Morulae in white blood cells in 20% of patients first week after onset
 - *E. chaffeensis* seen in monocytes, *E. ewingii* seen in granulocytes
- Serology: IgG IFA (not species specific)
 - Detectable titer 7-10 days after onset
 - 2 samples 2-4 weeks apart: 4 fold rise in titer
 - IgM rises at same time as IgG, may remain elevated for months, and is less specific (false positives)

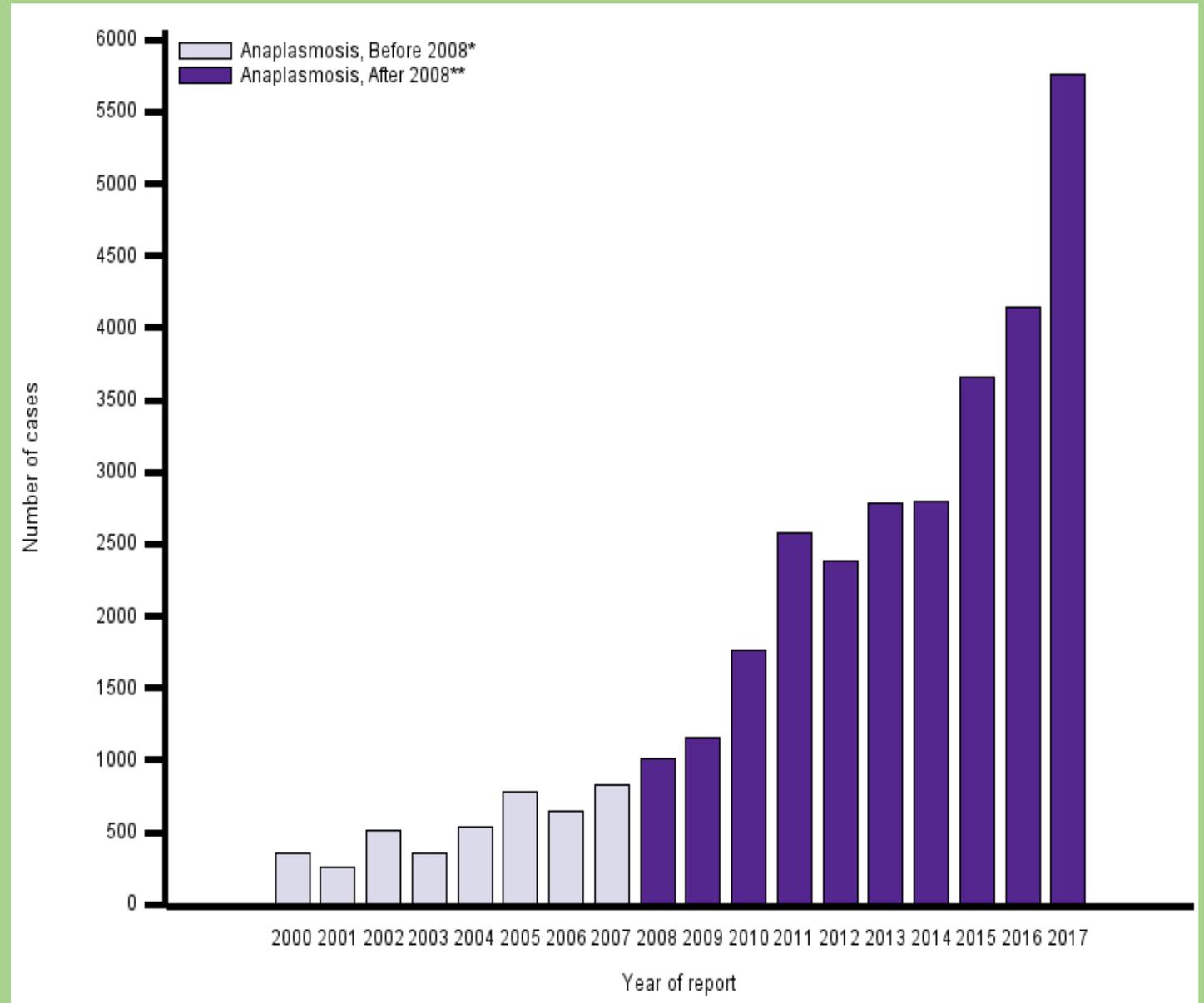
Number of U.S. Anaplasmosis Cases Reported to the CDC, 2000-2017

The graph displays the number of human cases of anaplasmosis reported to CDC annually from 2000 through 2017. *From 2000 to 2008, anaplasmosis was included in the reporting category “human granulocytic ehrlichiosis” in reports to NNDSS. **

Since 2008, anaplasmosis has been reported to NNDSS in its own reporting category called “*Anaplasma phagocytophilum*”.

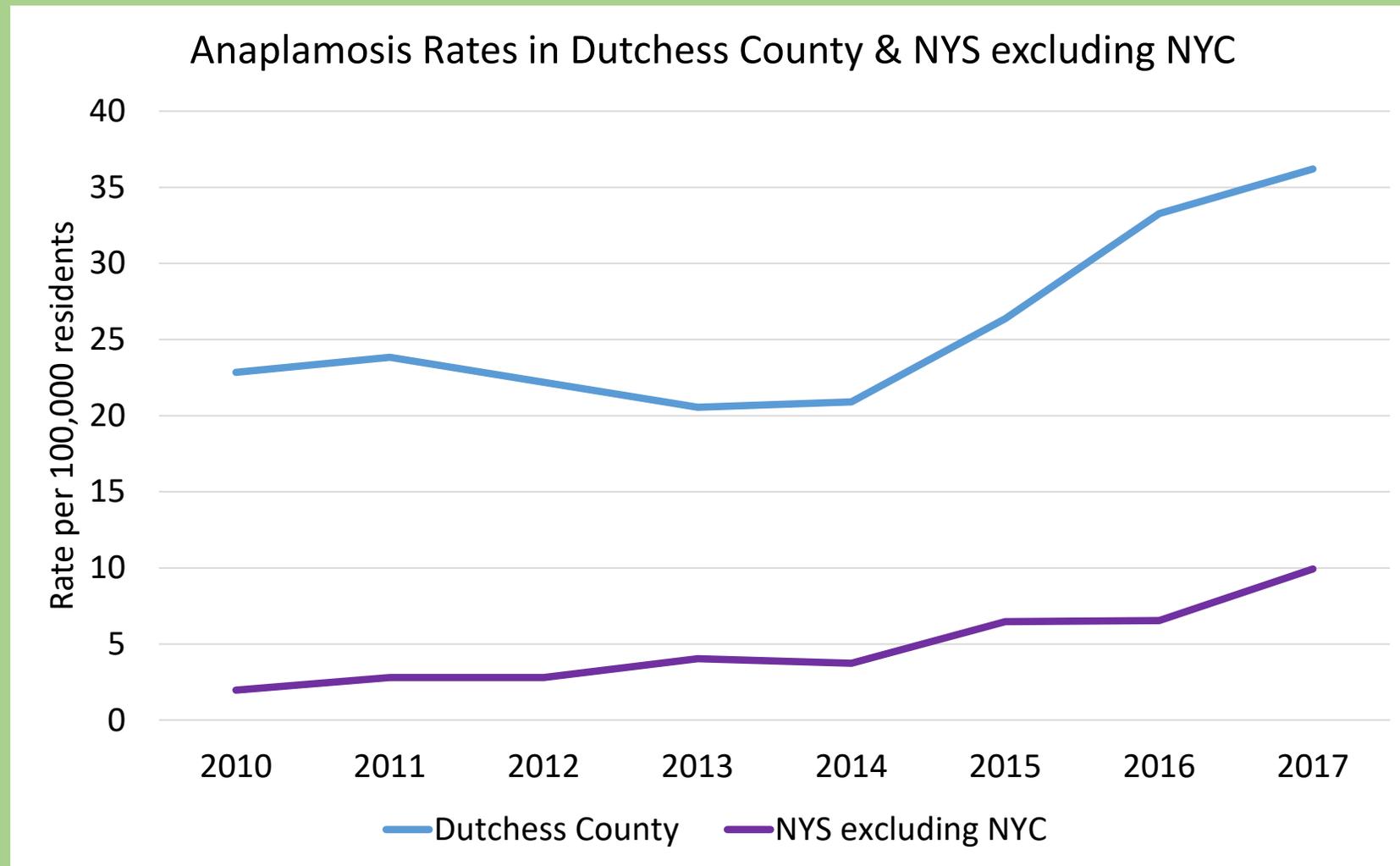
Cases of anaplasmosis have generally increased from 350 cases in 2000, when the disease became nationally notifiable, to 1,163 cases in 2009, and 5,762 cases in 2017.

The number of cases increased 39% between 2016 and 2017.



Anaplasmosis incidence per 100,000 NYS & Dutchess County, NY 2010-2017

The total number of new cases of Anaplasmosis in Dutchess County in 2017 was 107.

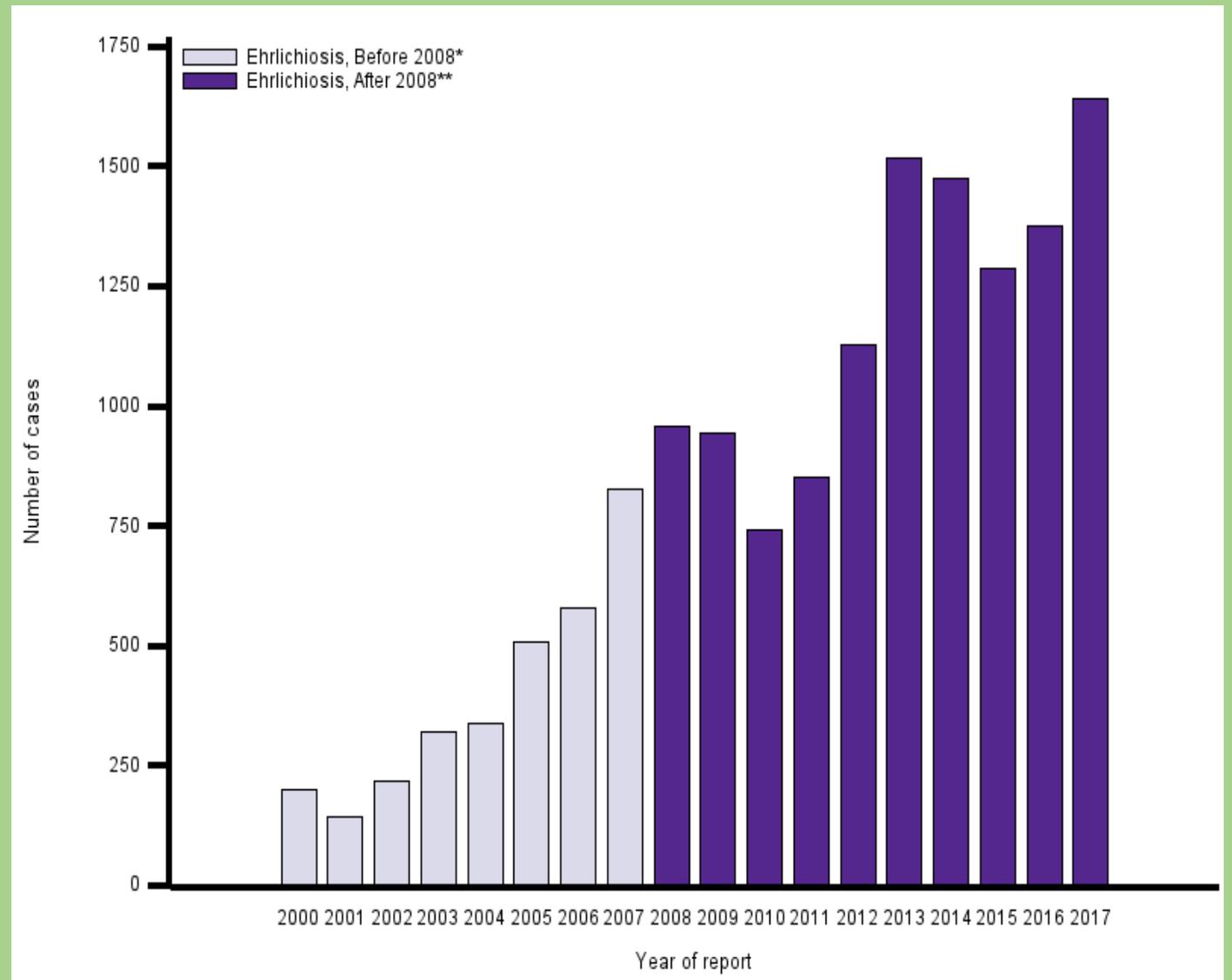


Number of U.S. *Ehrlichia chaffeensis* Cases Reported to the CDC, 1994-2017

The graph displays the number of human cases of ehrlichiosis caused by *Ehrlichia chaffeensis* reported to CDC annually from 2000 through 2017. *From 2000 to 2008, ehrlichiosis was included in the reporting category “human monocytic ehrlichiosis” in reports to NNDSS. **

Since 2008, ehrlichiosis has been reported to NNDSS under the categories “*Ehrlichia chaffeensis* infections,” “*Ehrlichia ewingii* infections,” and “Undetermined ehrlichiosis/anaplasmosis infections”, which include infections caused by *Ehrlichia muris eauclairensis*.

Only *E. chaffeensis* infections are shown above.



Annual reported incidence (per million population) for *E. chaffeensis* in the United States for 2017. (NN= Not notifiable)

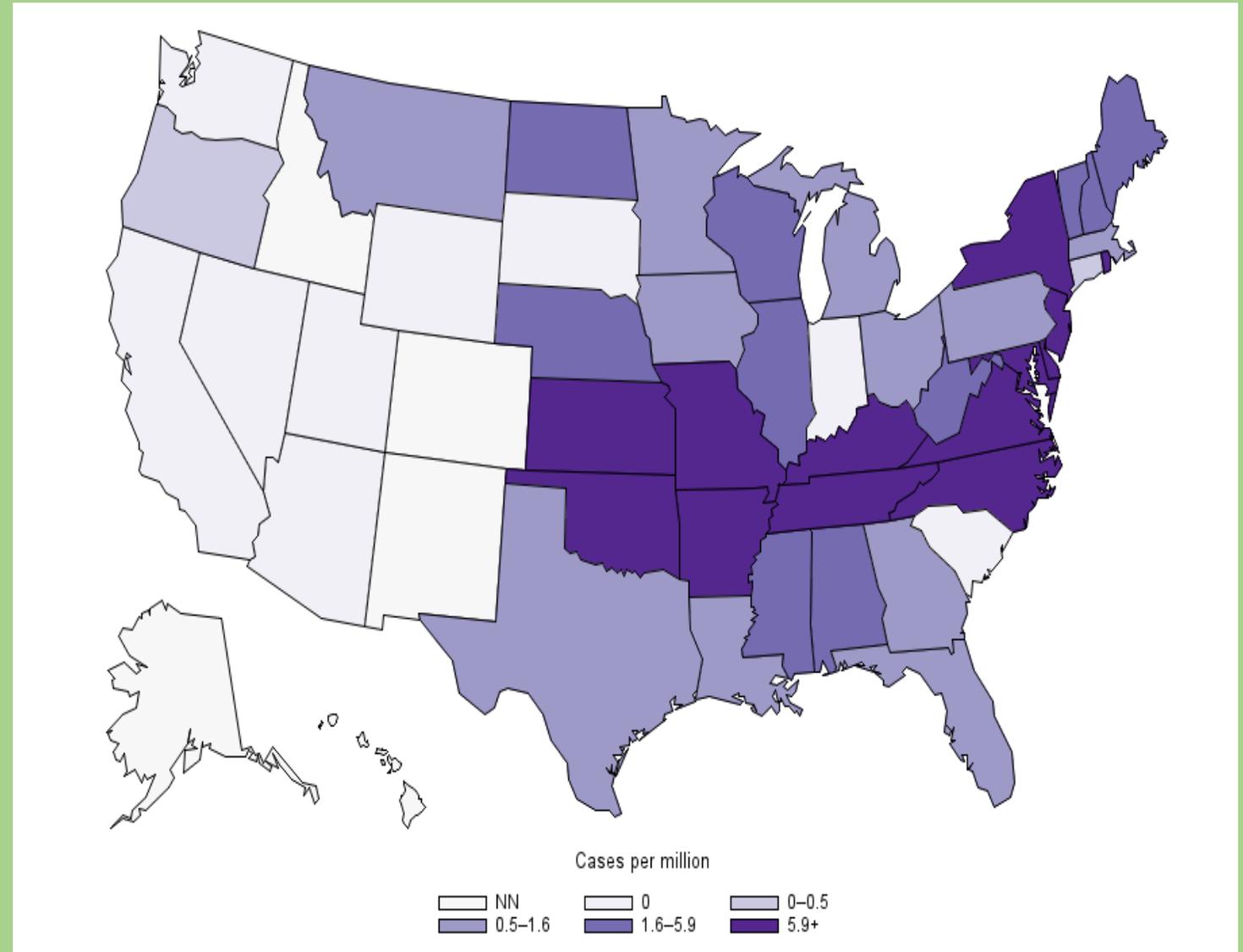
Ehrlichiosis is most frequently reported from the southeastern and south-central United States, from the East Coast extending westward to Texas.

These areas overlapping with the known geographic distribution of the lone star tick (*Amblyomma americanum*), the primary tick vector of *E. chaffeensis* and *E. ewingii*.

In 2017, four states (Missouri, Arkansas, New York, and Virginia) accounted for more than 50% of all reported cases of ehrlichiosis.

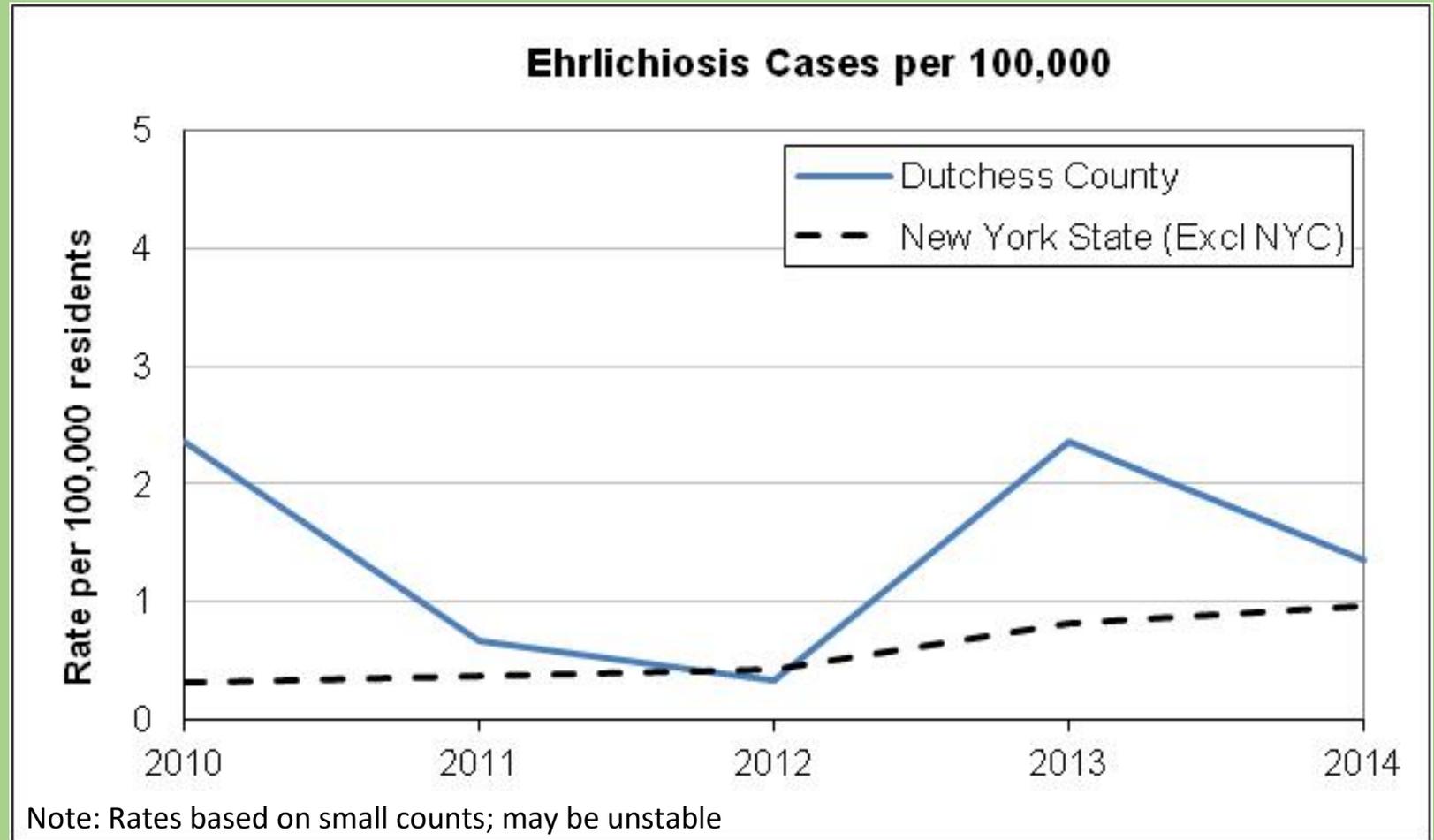
Ehrlichiosis caused by *E. muris eauclairensis* has been found in patients living in Minnesota and Wisconsin.

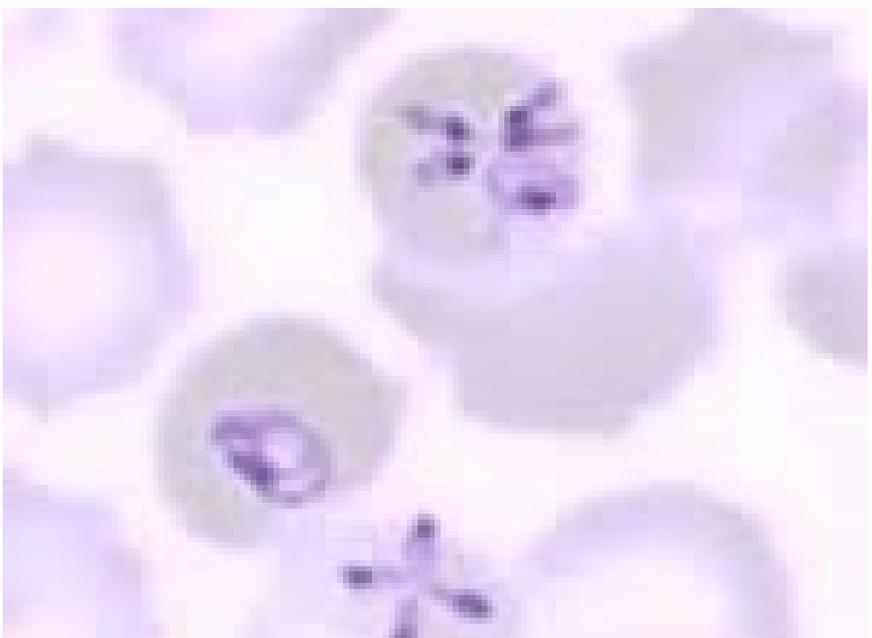
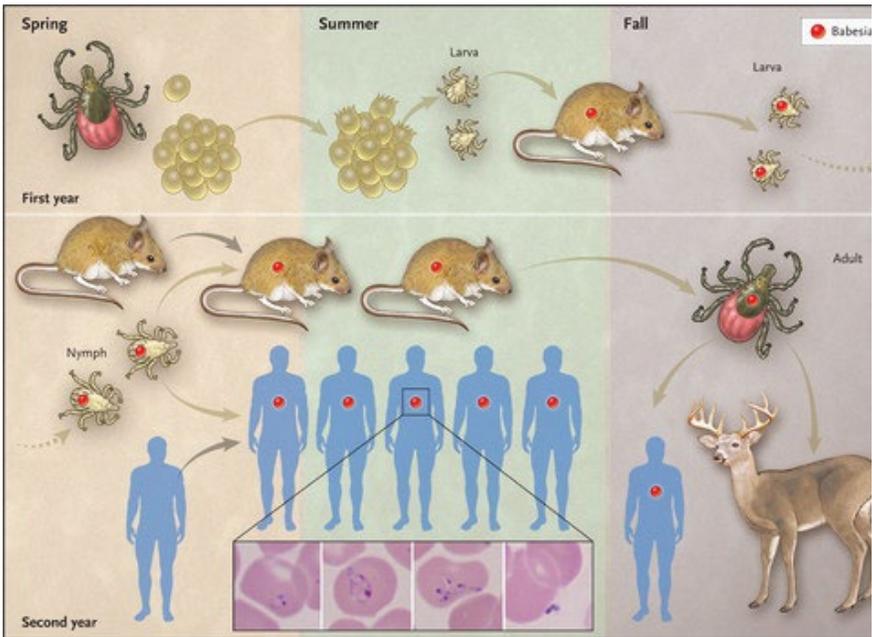
The primary tick vector for *E. muris eauclairensis* is *Ixodes scapularis*, the tick that spreads [Lyme disease](#), [anaplasmosis](#), [Powassan virus infection](#), and [babesiosis](#).



Ehrlichiosis incidence per 100,000 NYS & Dutchess County, NY 2010-2014

The total number of new cases of Ehrlichiosis in Dutchess County in 2014 was 4.



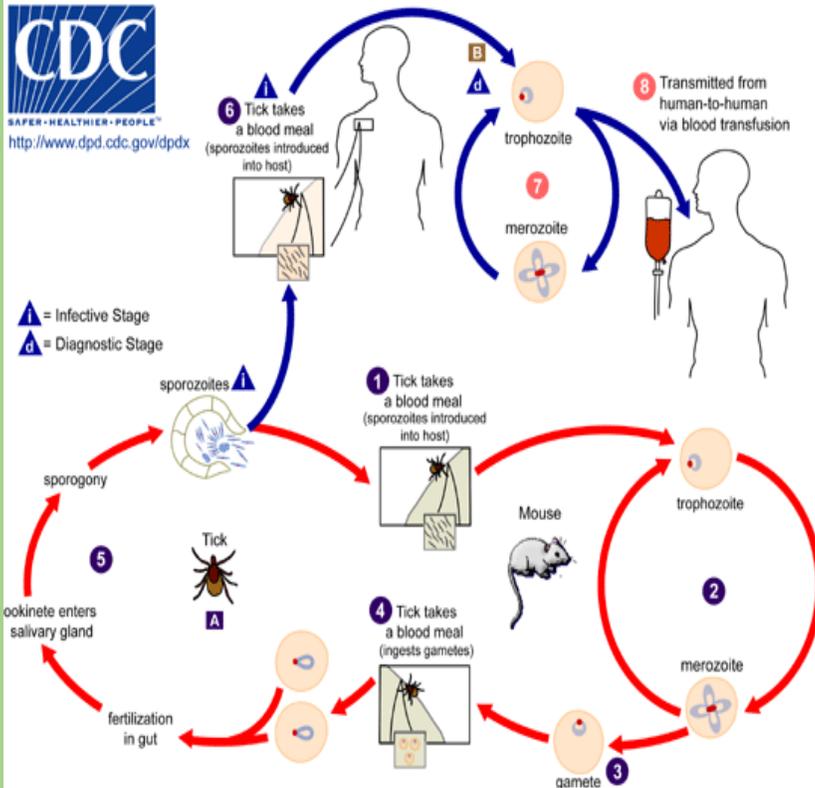


Babesiosis

Babesiosis



http://www.cdc.gov/dpdx

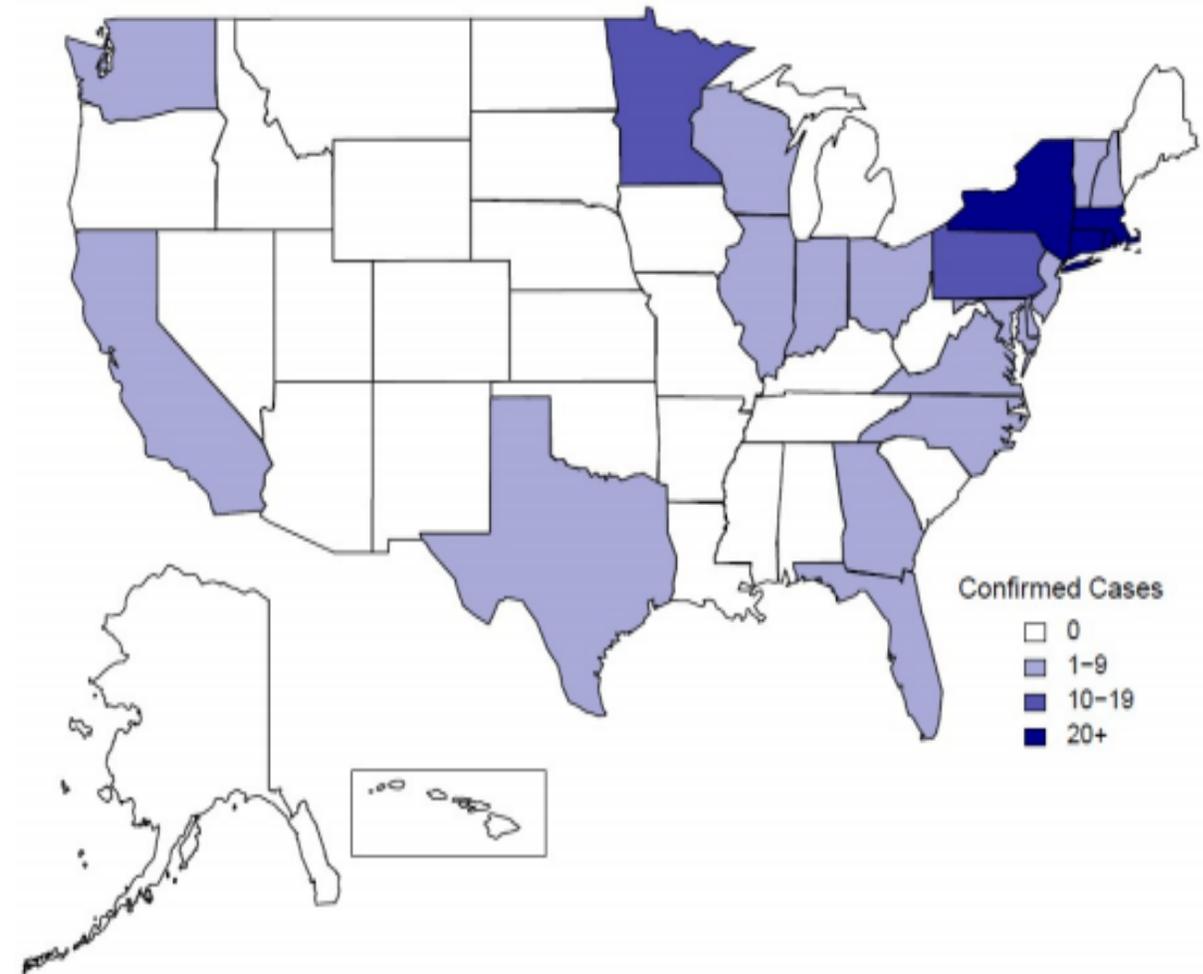


Causative Agent	<i>Babesia microti & duncani</i>
Incubation period	<ul style="list-style-type: none"> Usually few weeks or months after exposure Symptoms may first appear or recur many months later, particularly in immunosuppressed.
Classic Symptoms	<ul style="list-style-type: none"> Hemolytic anemia and nonspecific flu-like symptoms (e.g., fever, chills, body aches, weakness, fatigue). Some patients have splenomegaly, hepatomegaly, or jaundice.
Risk Factors	<ul style="list-style-type: none"> Asplenia, advanced age, other causes of immunocompromise. Increase risk for severe disease: marked thrombocytopenia, disseminated intravascular coagulation, hemodynamic instability, acute respiratory distress, myocardial infarction, renal failure, hepatic compromise, altered mental status, and death.
Laboratory tests	<ul style="list-style-type: none"> Anemia and thrombocytopenia Blood Smear: thick and thin, Giemsa-stained PCR IFA: detects antibodies in 88-96%
Treatment	<ul style="list-style-type: none"> Most asymptomatic infections do not require treatment Ill patients: treat for at least 7-10 days with a combination of two prescription medications — typically either: <ul style="list-style-type: none"> atovaquone PLUS azithromycin; OR clindamycin PLUS quinine (this combination is the standard of care for severely ill patients)

Babesiosis and the Blood supply

- Tick bite is predominant mode of transmission
- Transmission can also occur with transfusion of blood from asymptotically infected donor
- Surveillance includes transfusion-transmitted babesiosis
 - Provider history taking to include questions about blood donation/receipt necessary for accurate counts
- FDA has proposed the following strategy as soon as licensed tests become available:
 - Year round nation-wide testing with antibody-based tests
 - Year round testing by NAT and antibody based tests in high risk regions

Figure 3: State-Level Distribution of Transfusion-Transmitted Babesiosis Cases, 1979-2014



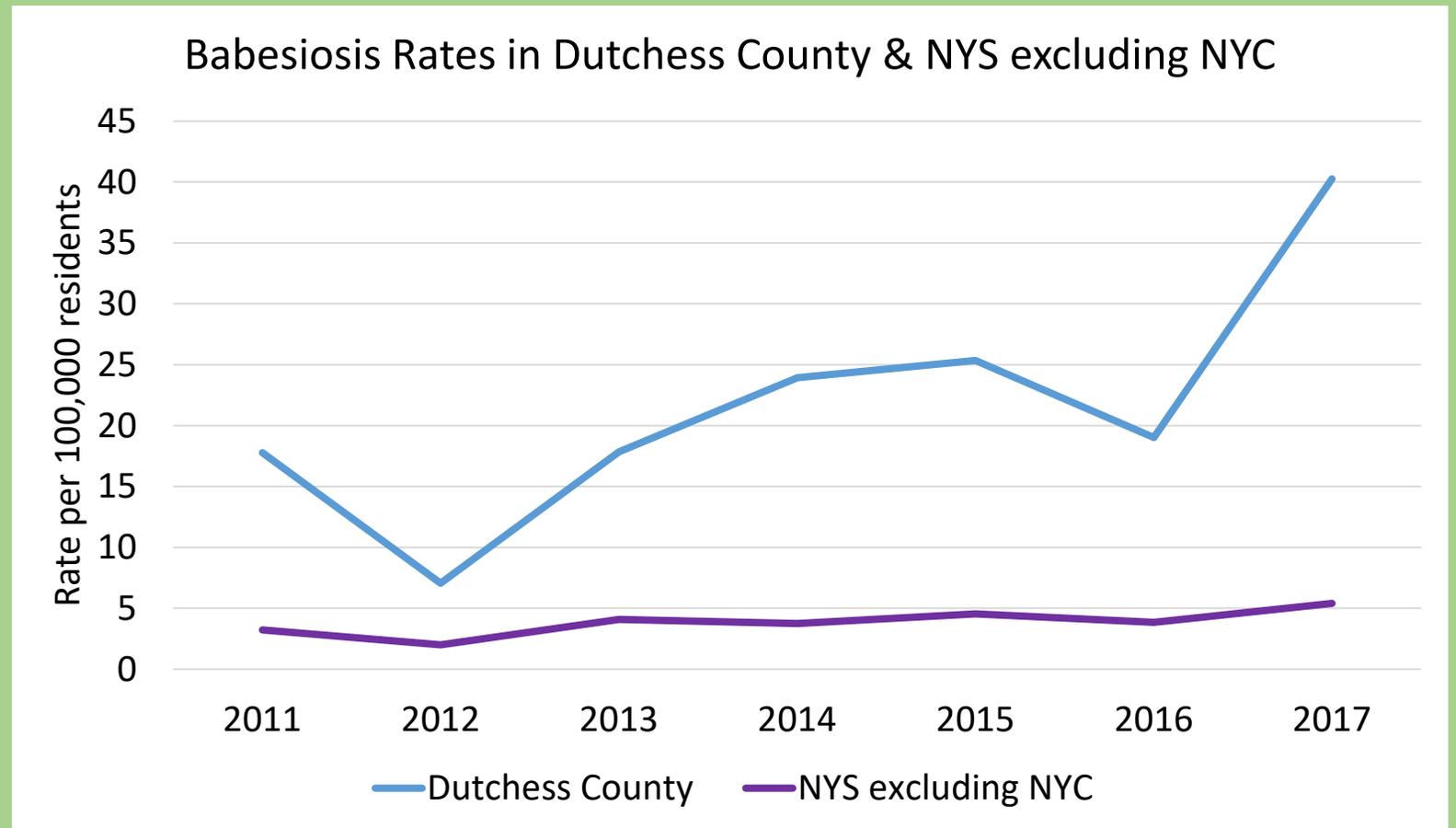
Atovaquone is VERY Expensive!

- The out of pocket cost for a 10 day course of treatment can be over \$1000, even for the generic.
- Uninsured patients may require assistance in order to gain access to medication.
 - GlaxoSmithKline has an assistance program:
<http://www.gskforyou.com/patient-assistance-programs/gsk-access.html>
- Many insurance companies require prior authorization. Providers should anticipate being asked for documentation of infection.



Babesiosis incidence per 100,000 NYS & Dutchess County, NY 2011-2017

The total number of new cases of Babesiosis in Dutchess County in 2017 was 119.



Note: In 2011, the case definition changed to include both confirmed and probable cases. Data prior to 2011 are not presented in the chart as they should not be directly compared with later rates.

Data Source: New York State Department of Health Communicable Disease Registry

Percent of Anaplasmosis Cases Reported each Month, 1994-2010

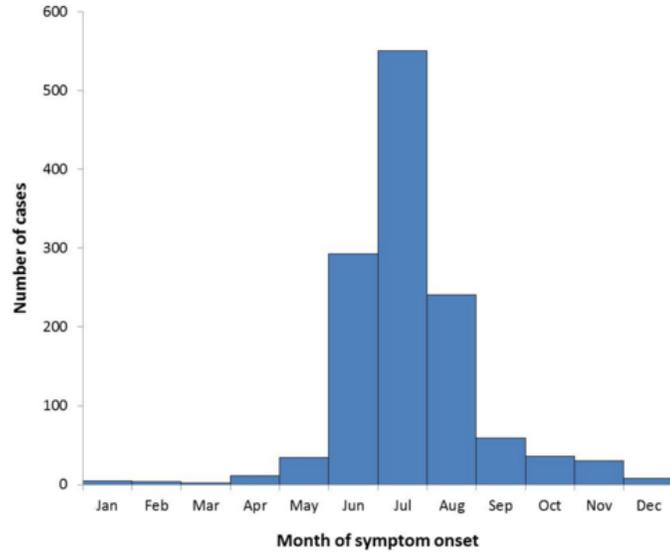
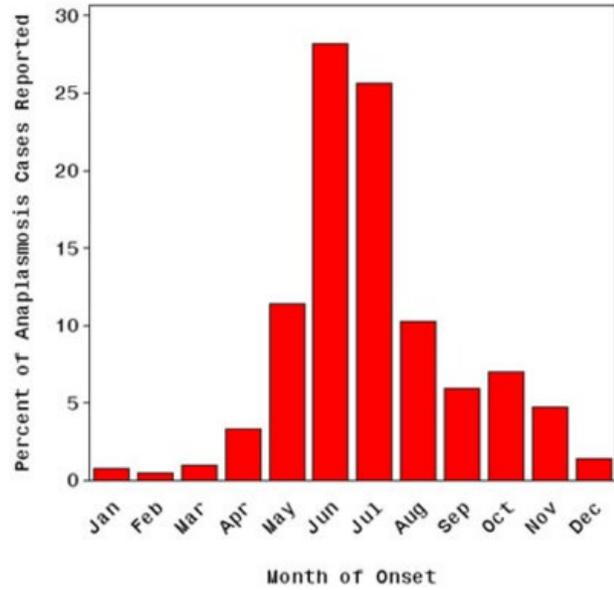
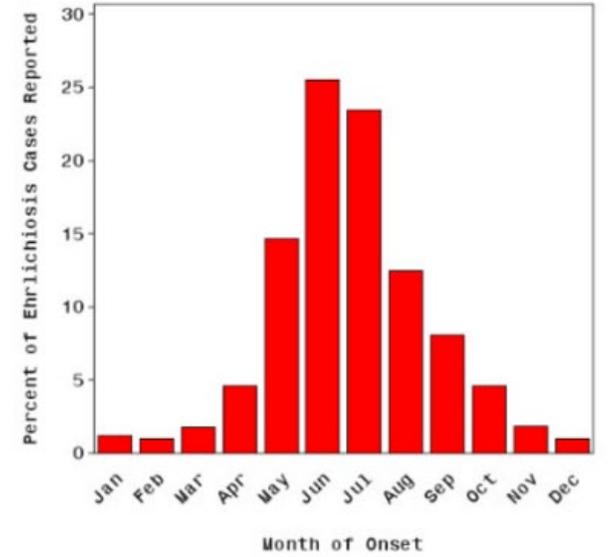
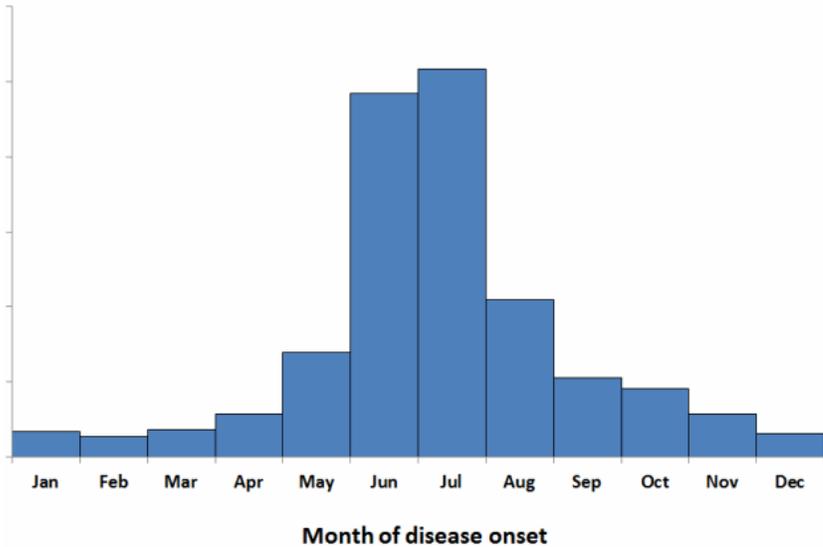


FIGURE 3. Number of reported cases of babesiosis, by month of symptom onset* — 2013

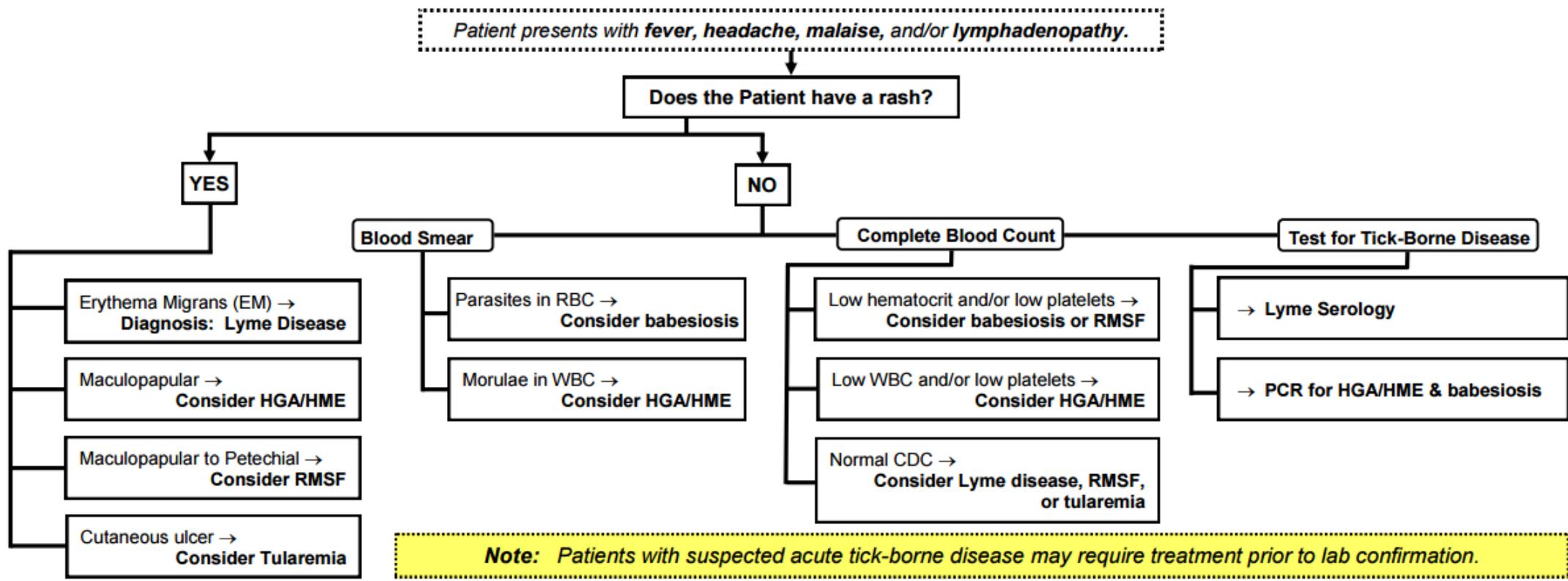
Percent of Ehrlichiosis Cases Reported each Month, 1994-2010



Red Lyme disease cases by month of disease onset--United States, 2000-2010



Peaks in onset correspond to the months when nymphal ticks are most abundant and active



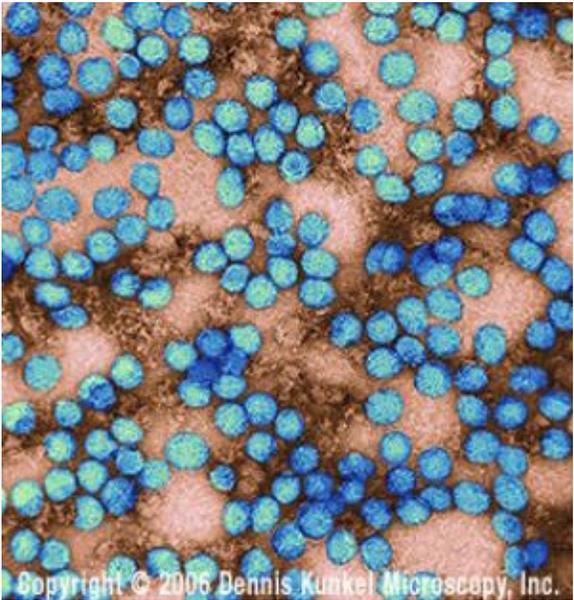
Courtesy of Dutchess County Department of Health - 85 Civic Center Plaza - Suite 106 - Poughkeepsie, New York 12601 (845) 486-3402 - Communicable Disease Control Division

This tool is intended to serve as a diagnostic framework for tick-borne disease, not to make a final diagnosis.
Additional information on diagnosis and treatment may be found online at www.cdc.gov/ticks

* Algorithm adopted from New York State Department of Health's Diagnosing Tick Borne Disease flyer, Massachusetts Department of Public Health Tick-borne Disease Physician's Reference Manual, and the Centers for Disease Control and Prevention's Tickborne Diseases of the United States: A Reference Manual for Health Care Providers.

Potential threats from emerging tick-borne diseases

Recently recognized and emerging pathogens in the United States



POWASSAN VIRUS DISEASE

Powassan Virus

RNA virus of genus *Flavivirus*

2 genetic lineages

Lineage 1 POWV transmitted by
Ixodes cookei and *Ixodes marxi*
Rarely bite humans

Lineage 2 DTV transmitted by
Ixodes scapularis



Types of ticks

Groundhog tick, also known as woodchuck tick (female)

Millimeters



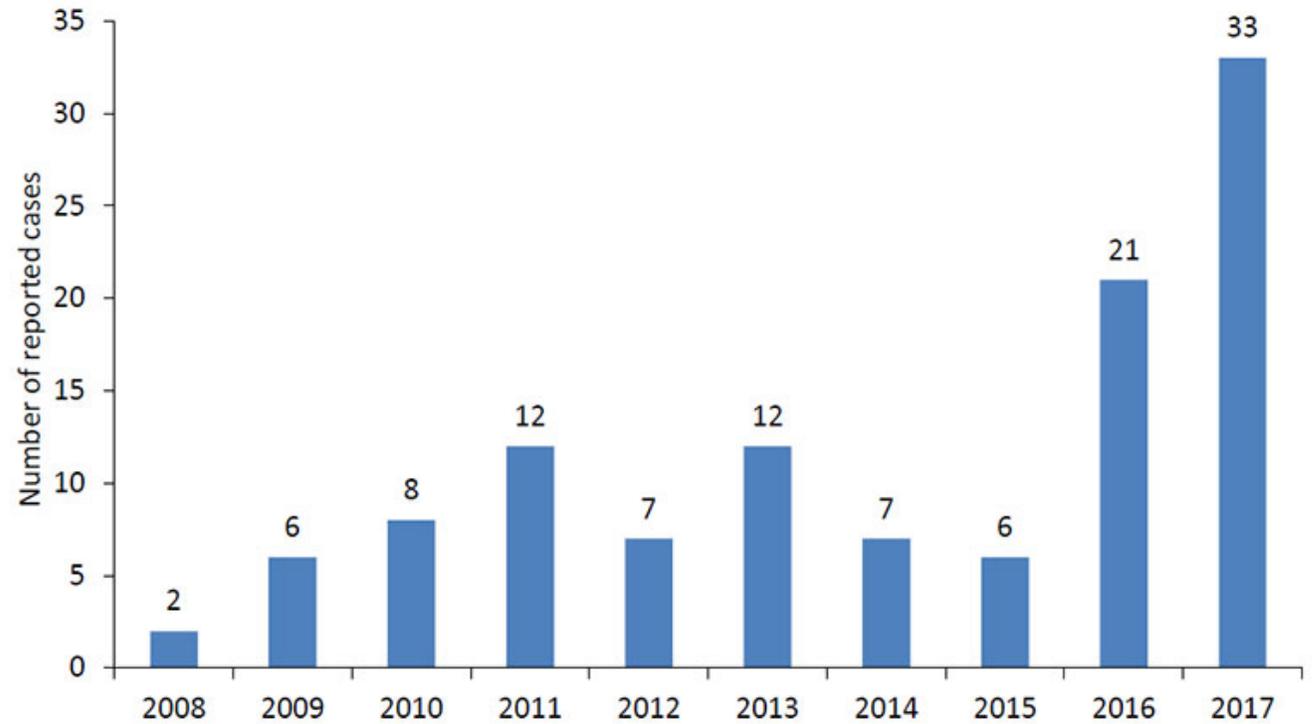
Groundhog Tick

Ixodes cookei

Causative Agent	<i>Powassan Virus and Deer Tick Virus</i>
Incubation period	1 week to 1 month
Symptoms	<ul style="list-style-type: none"> •Asymptomatic infection is common •Can cause encephalitis and meningitis • Symptoms can include fever, headache, vomiting, weakness, confusion, loss of coordination, speech difficulties, and seizures.
Outcomes	<ul style="list-style-type: none"> •10 % of cases are fatal •50% of survivors have permanent neurological symptoms such as headaches, muscle wasting, and memory problems
Laboratory tests	<ul style="list-style-type: none"> •Testing done at Wadsworth Public Health laboratory •Serum +/- CSF- virus specific IgM and neutralizing antibodies •Acute and convalescent samples to confirm diagnosis •Fatal cases: nucleic acid amplification, histopath, immunohistochemistry, can virus culture of autopsy tissue.
Treatment	<ul style="list-style-type: none"> •No specific treatment- supportive care

Source: Centers for Disease Control and Prevention Powassan

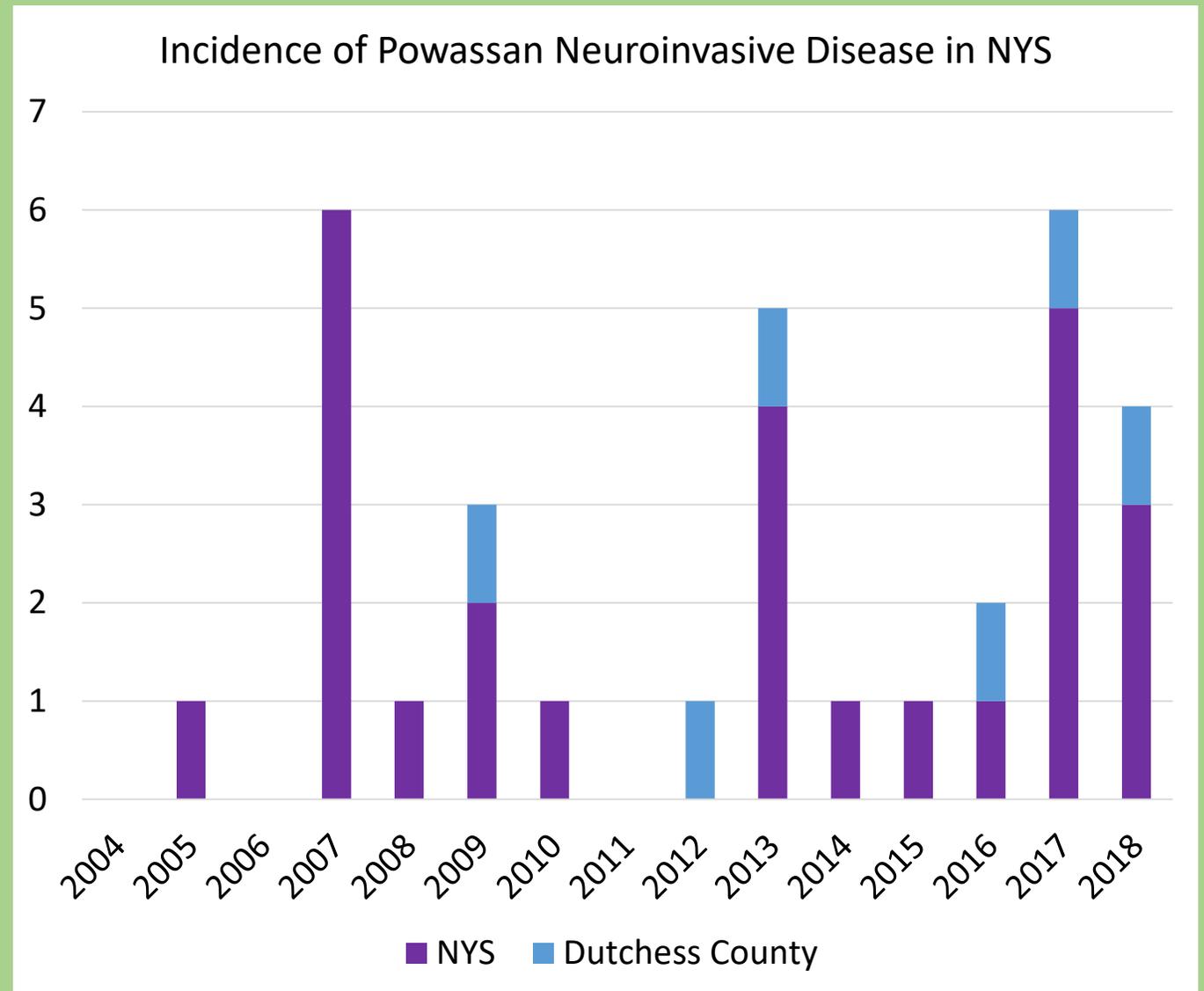
Powassan virus
neuroinvasive
disease cases
reported by year,
2008–2017

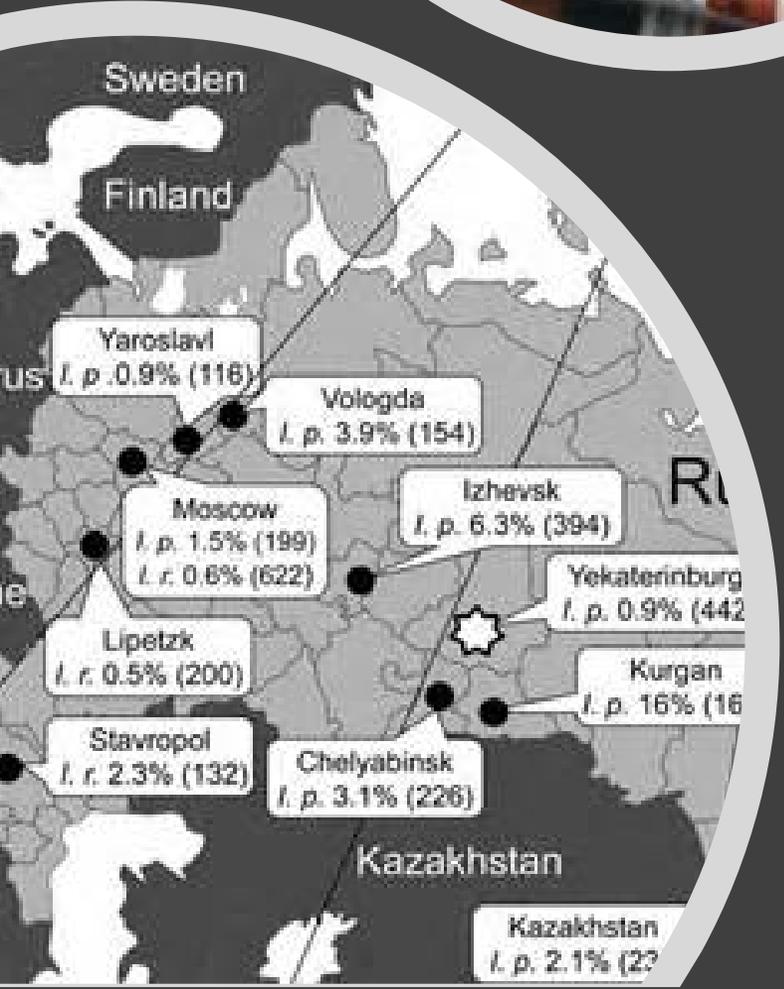
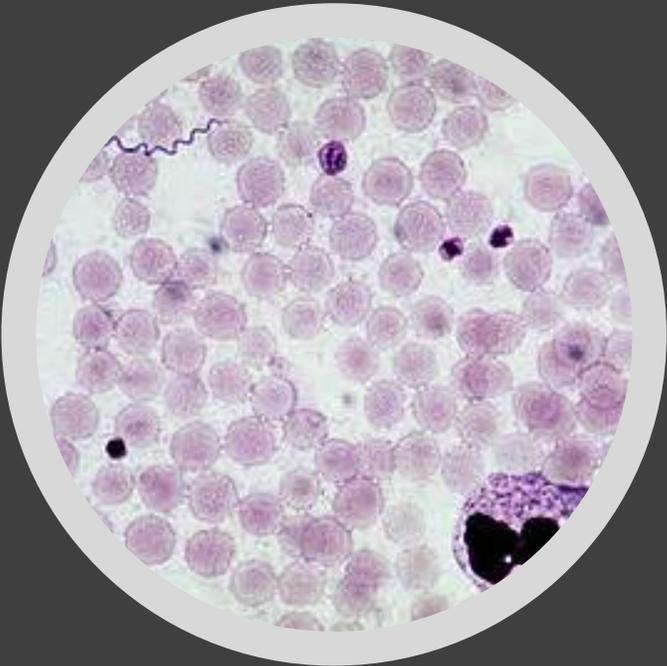


Reported cases of Neuroinvasive Powassan Disease in NYS and Dutchess County 2004-2018

New York State has reported 26 cases of POWV neuroinvasive disease from 2004 to 2018.

Dutchess County has confirmed 6 cases during that period.





Borrelia miyamotoi

Borrelia miyamotoi

- Relapsing fever spirochete- only one found in hard ticks
 - Only distantly related to *B. burgdorferi*
- First identified 1995 in ticks in Japan
- Thought to have a similar geographic distribution to Lyme disease
- Incidence is unknown- not yet a reportable disease
 - 97 cases identified in NE United States 2013-2014 as part of case series
 - Expected to become reportable when there is a greater availability of testing
 - NYSDOH doing tick surveillance for *B. miyamotoi*

Causative Agent	<i>Borrelia miyamotoi</i>
Transmission	<i>Ixodes</i> ticks <i>I. scapularis</i> in Dutchess County
Symptoms	<ul style="list-style-type: none">•Clinical presentation more similar to anaplasmosis than Lyme disease•Most common symptoms: fever, chills and headache<ul style="list-style-type: none">•Relapsing fevers•Fatigue , arthralgia, and body aches are also common•Rash in only 4/51 patients
Laboratory tests	<ul style="list-style-type: none">• Will not be detected when testing for Lyme disease by 2-tier protocol•Only commercial lab testing is Imugen in Norwood, MA<ul style="list-style-type: none">•PCR : acute cases only•Serology: acute cases likely to be seronegative. Collect convalescent specimen in 3-4 weeks.
Treatment	2-4 weeks doxycycline

Tick Bites that Cause Beef Allergy

Eastern USA,
people are
allergic to meat.

allergies are
caused by a bite from the lone

star tick. After food allergies,
symptoms appear 4 to 8 hours after



#4 Hives, digestive upset,
asthma, and even potentially
life-threatening anaphylaxis
may occur.

#5 Some people get over
meat allergy in a few years,
but some have to use
antihistamines and carry
Epi-Pens indefinitely, so
best not to get bitten by the
lone star tick.

Alpha Gal
Syndrome

Alpha-gal syndrome is a recently identified type of food allergy to red meat. In the United States, the condition most often begins when a Lone Star tick bite transmits a sugar molecule called alpha-gal into the body. In some people, this triggers an immune system reaction that later produces mild to severe allergic reactions when they eat red meat

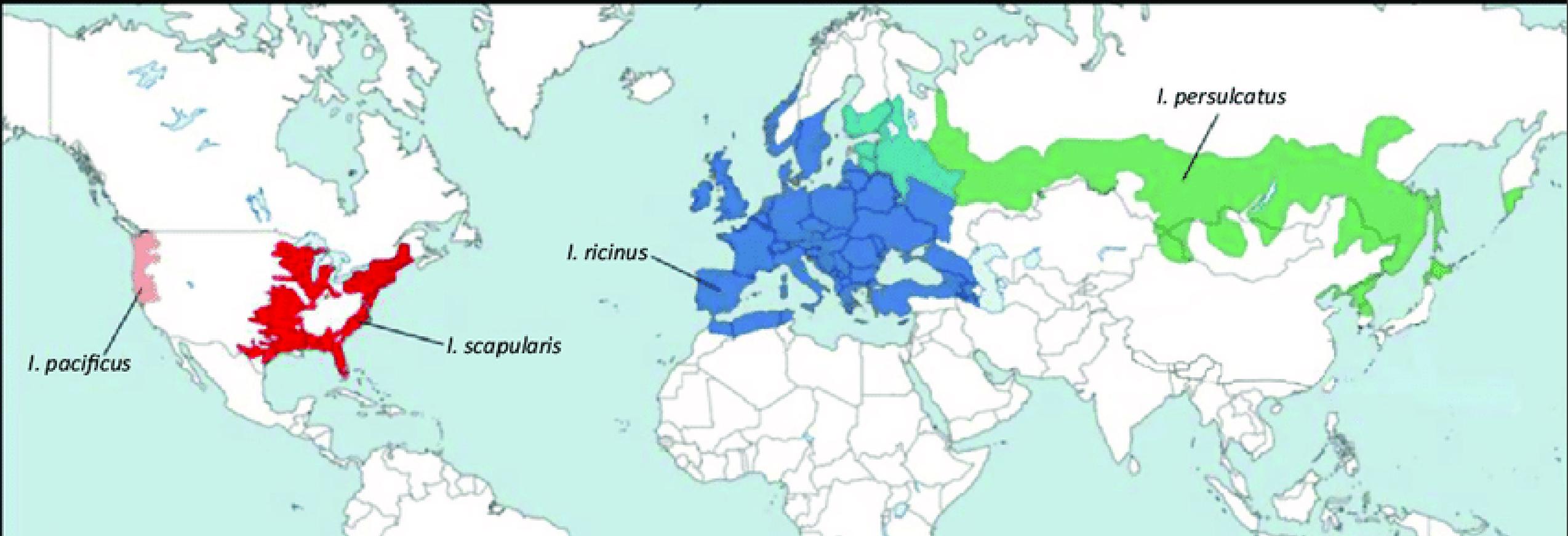
Alpha-Gal Syndrome





Borrelia mayonii

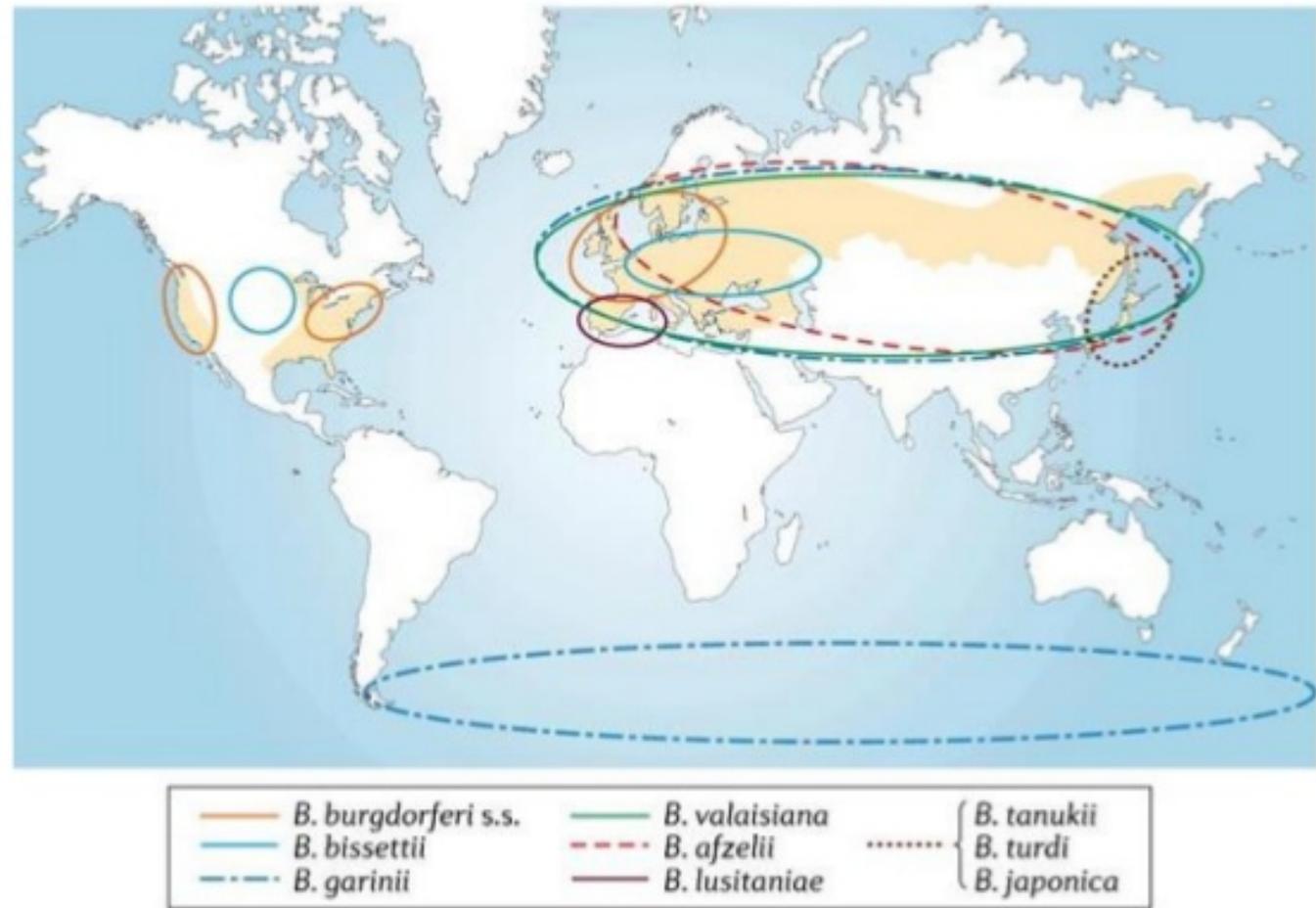
Emergent Borreliosis



Ixodes Species Ticks

Primary transmitters of Borreliosis

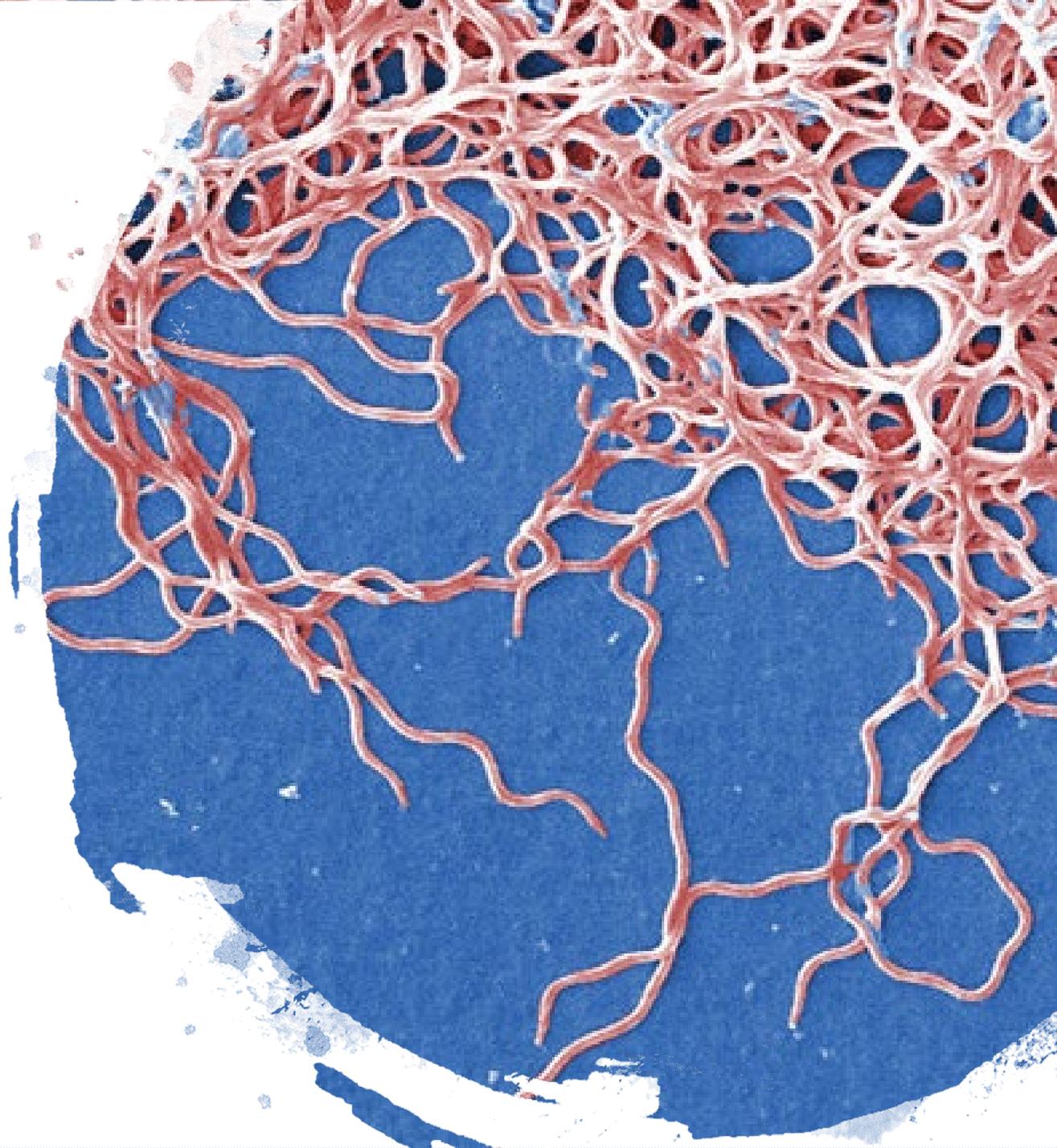
The geographical distribution of *Borrelia burgdorferi* sensu lato
10 years ago



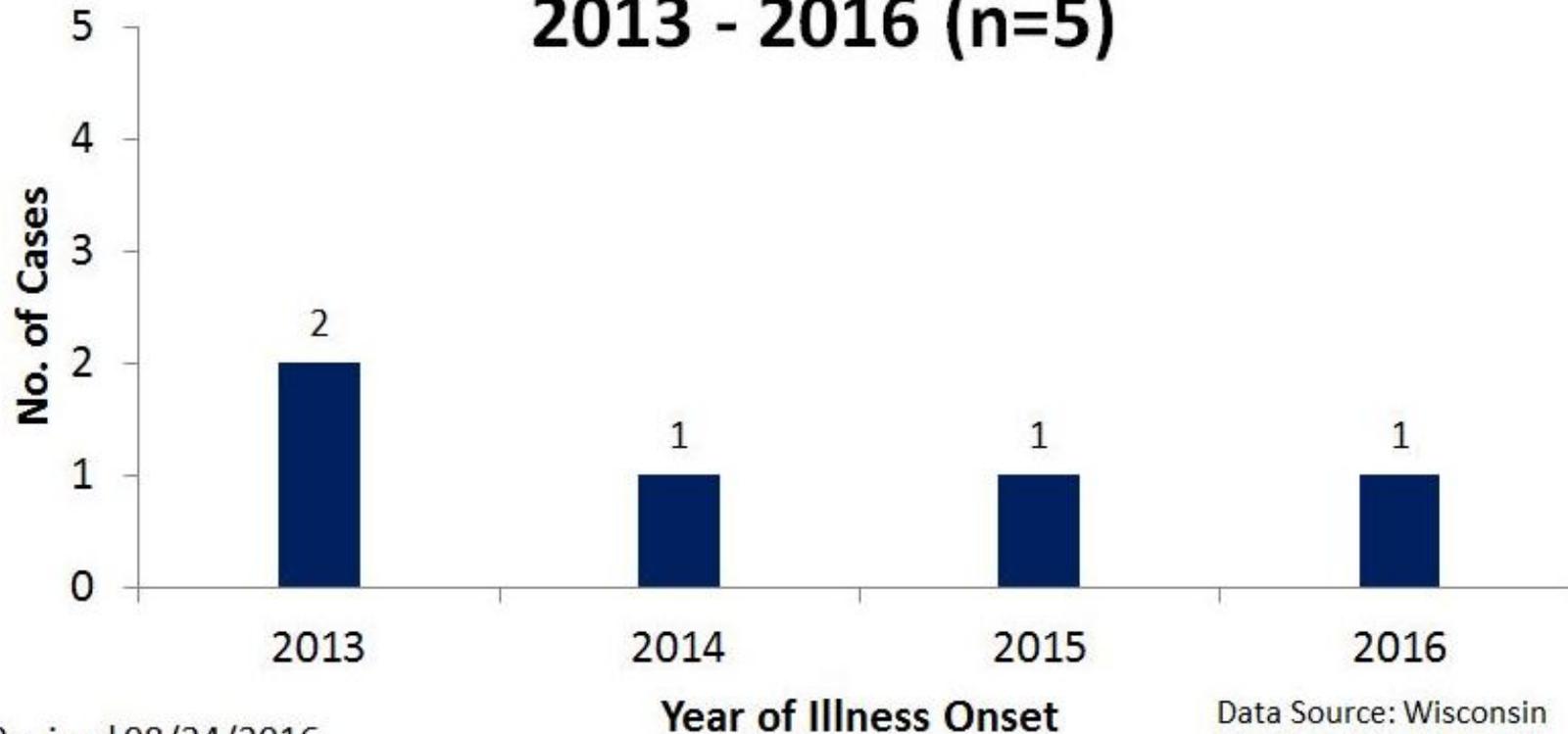
(K. Kurtenbach et al., 2006)

Borrelia mayonii

- Discovery of new bacterial species that causes Lyme disease in people announced by Mayo Clinic researchers 2/8/2016
- Found in 6 patients from the upper Midwest
- Found in 2.9% of *I. scapularis* ticks collected in region of patient exposure
- Detected on PCR- higher spirocheataemia than *B. burgdorferi*
- Believed to be a newly emerged organism in upper Midwestern USA
- Similar serologic response as patients with *B. burgdorferi*- 2 tier testing may detect
- Clinical presentation similar to *B. burgdorferi*, but may be associated with GI symptoms, and diffuse rash
- Treatment= as for *B. burgdorferi*



Wisconsin Reported Total Cases of Lyme Disease (*Borrelia mayonii*) 2013 - 2016 (n=5)



Revised 08/24/2016

Data Source: Wisconsin
Division of Public Health



*Ehrlichia
muris-like*

Monocytic Ehrlichiosis
found in Black-legged Tick

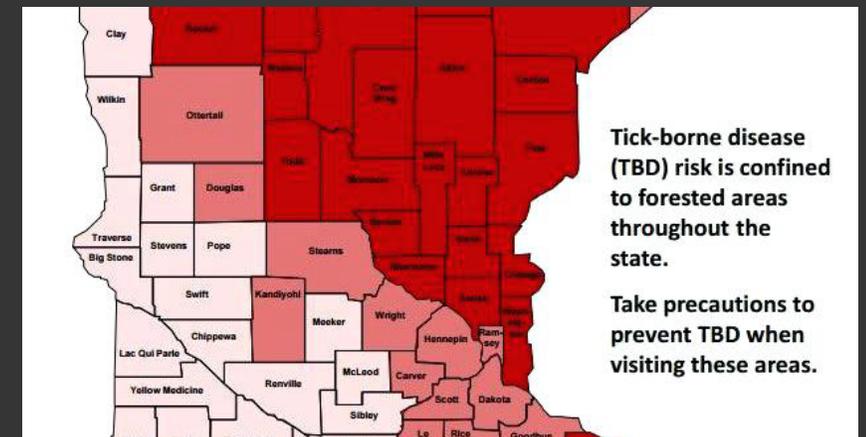
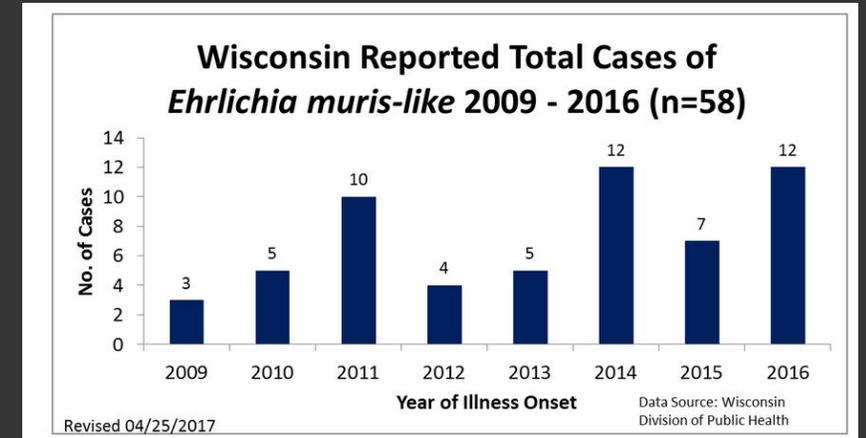


Initially
detected in 4
patients in
Minnesota and
Wisconsin in
2009

Has been detected in *I.
scapularis* ticks in Minnesota
and Wisconsin

Ehrlichia muris-like

- Study: 69 PCR positives in blood samples taken between 2004-2013.
- All positives reported tick exposure in Minnesota or Wisconsin
- Symptoms= fever, malaise, thrombocytopenia & lymphopenia
- Treatment= doxycycline



Heartland Virus

A Novel
Phlebovirus

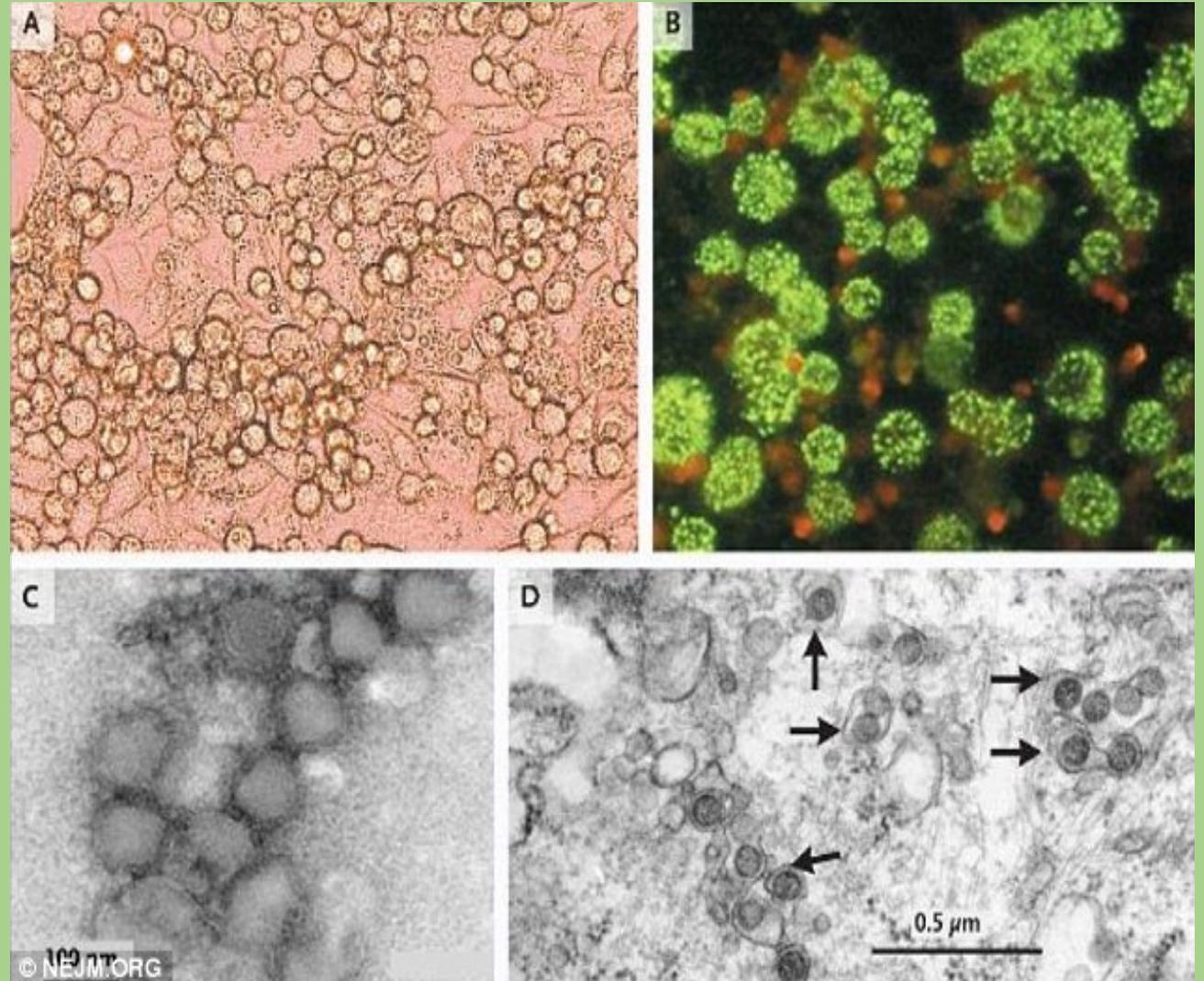


**CDC Finds New
'Heartland' Virus
in Missouri**

Aug 30, 2012 5:50 AM CDT

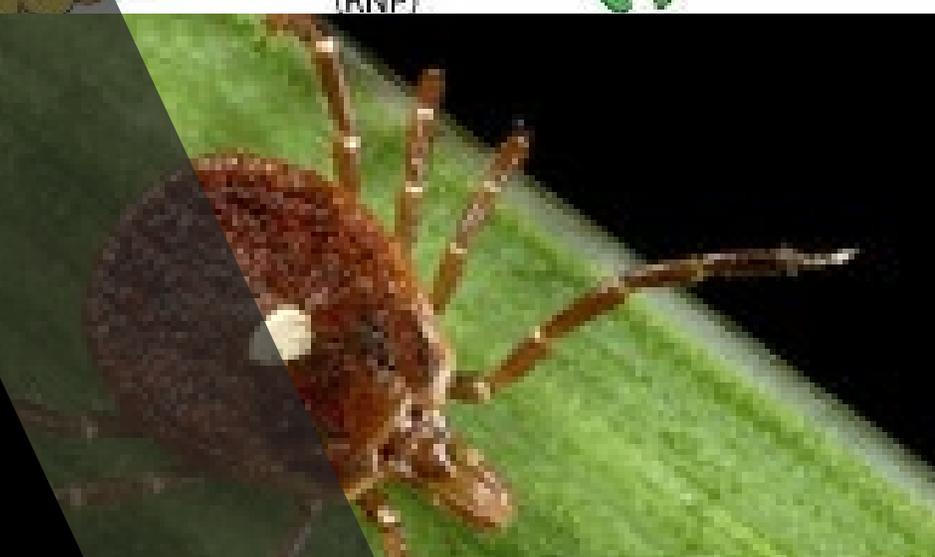
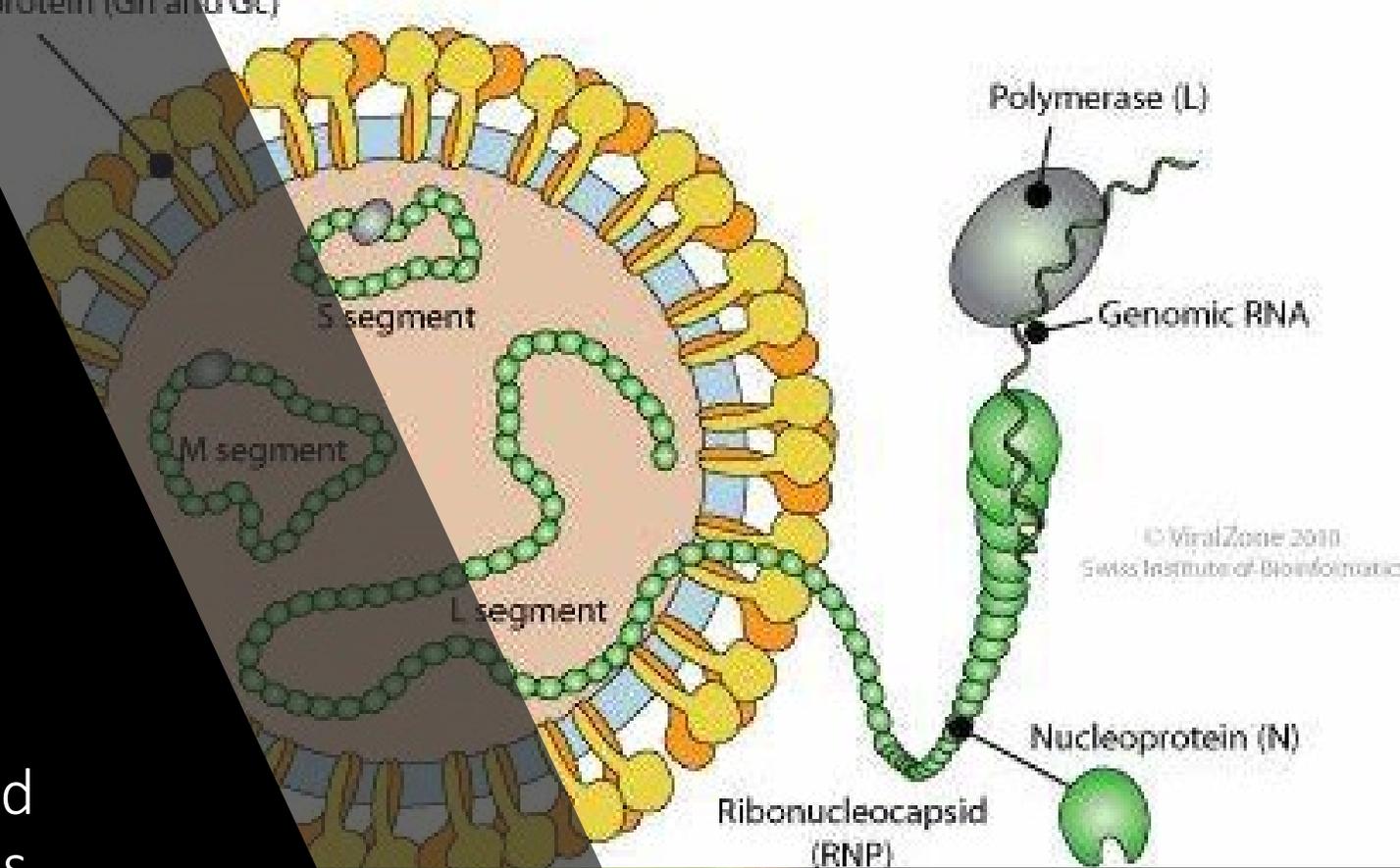
Heartland Virus

- First isolated from 3 Missouri farmers hospitalized for fever, thrombocytopenia and leukopenia in 2009.
- 6 additional cases 2012-2013. Five from Missouri, one from Tennessee.
- Unknown at this time if the virus may be found in other areas of the United States.



Studies suggest Heartland virus transmitted by Lone Star ticks

Novel Phlebovirus
Other Phleboviruses transmitted by mosquitoes, ticks or sandflies



HEARTLAND VIRUS SYMPTOMS

■ **FEVER
FATIGUE**

■ **HEADACHES & MUSCLE ACHES**

■ **LOSS OF APPETITE & NAUSEA**

■ **BRUISING**

■ **DIARRHEA**

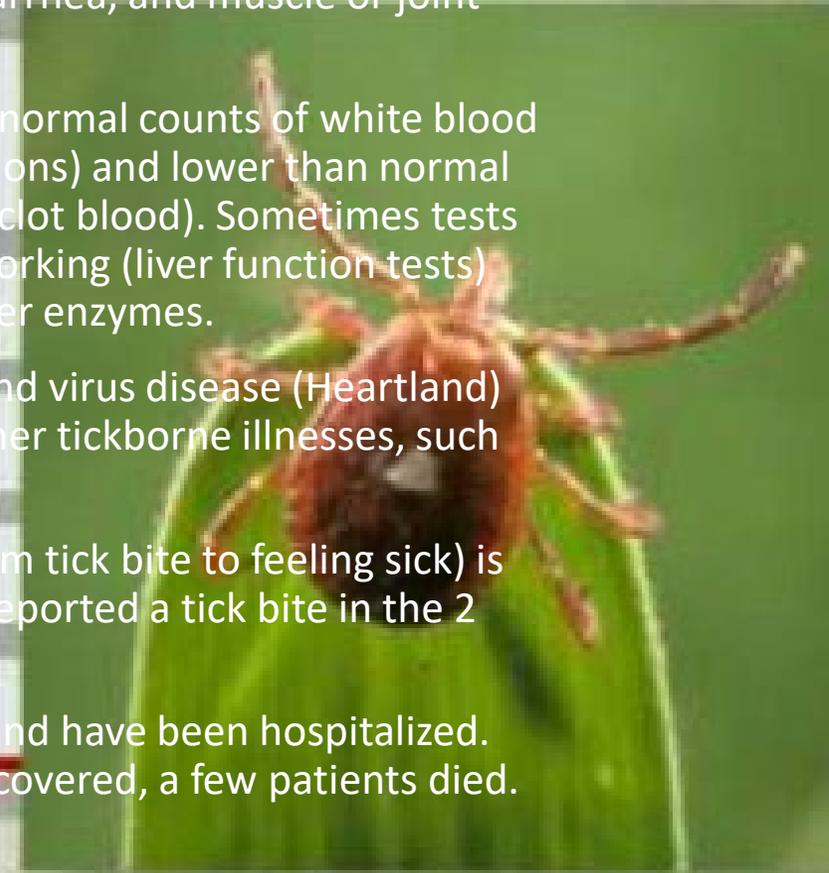
- Most patients have fever, fatigue (feeling tired), decreased appetite, headache, nausea, diarrhea, and muscle or joint pain.

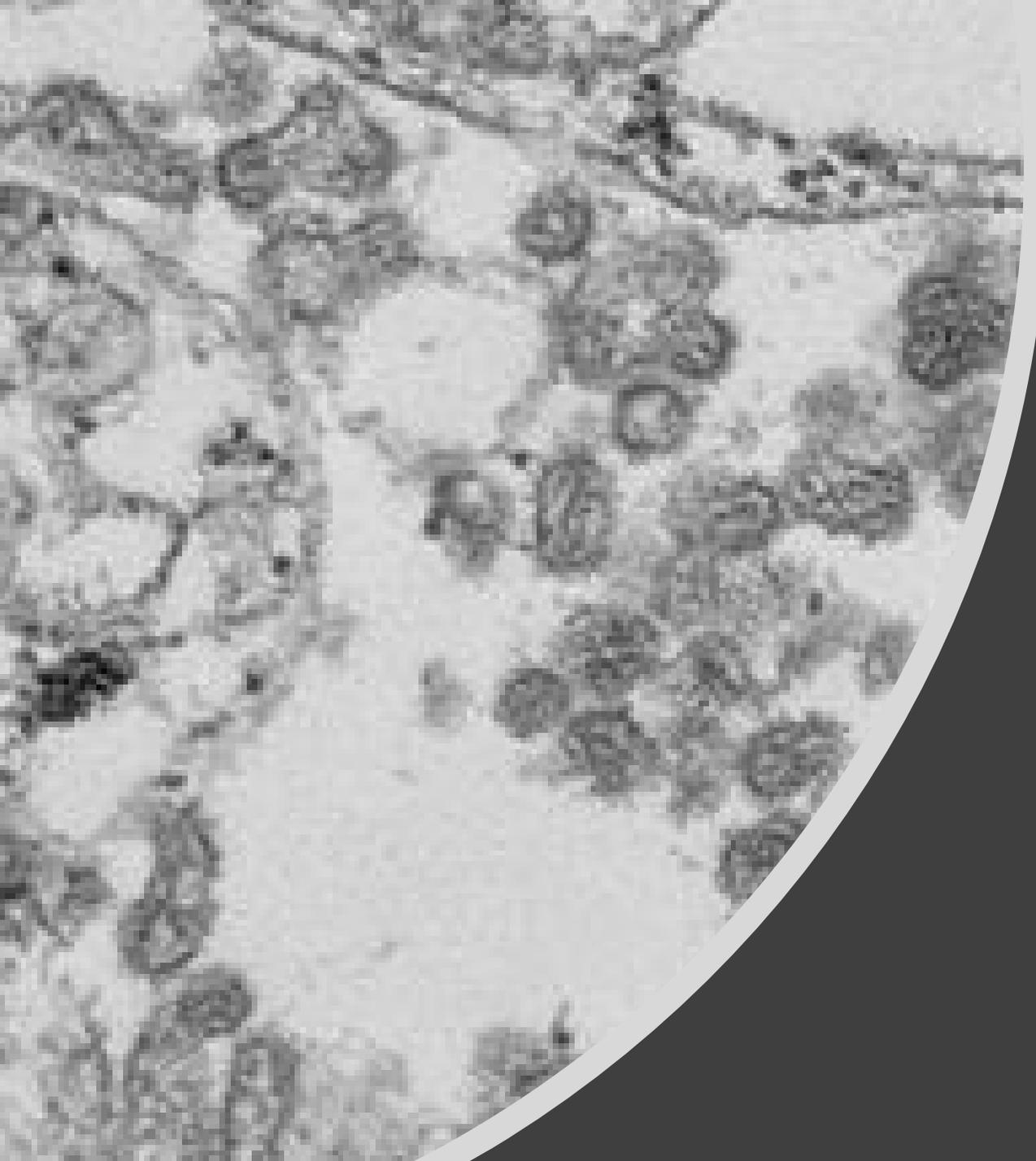
- Patients often have lower than normal counts of white blood cells (cells that help fight infections) and lower than normal counts of platelets (which help clot blood). Sometimes tests to check how well the liver is working (liver function tests) can show increased levels of liver enzymes.

- Symptoms and signs of Heartland virus disease (Heartland) are often similar to those of other tickborne illnesses, such as ehrlichiosis or anaplasmosis.

- The incubation period (time from tick bite to feeling sick) is not known, but most patients reported a tick bite in the 2 weeks before they felt sick.

- Almost all patients with Heartland have been hospitalized. Although most patients fully recovered, a few patients died.





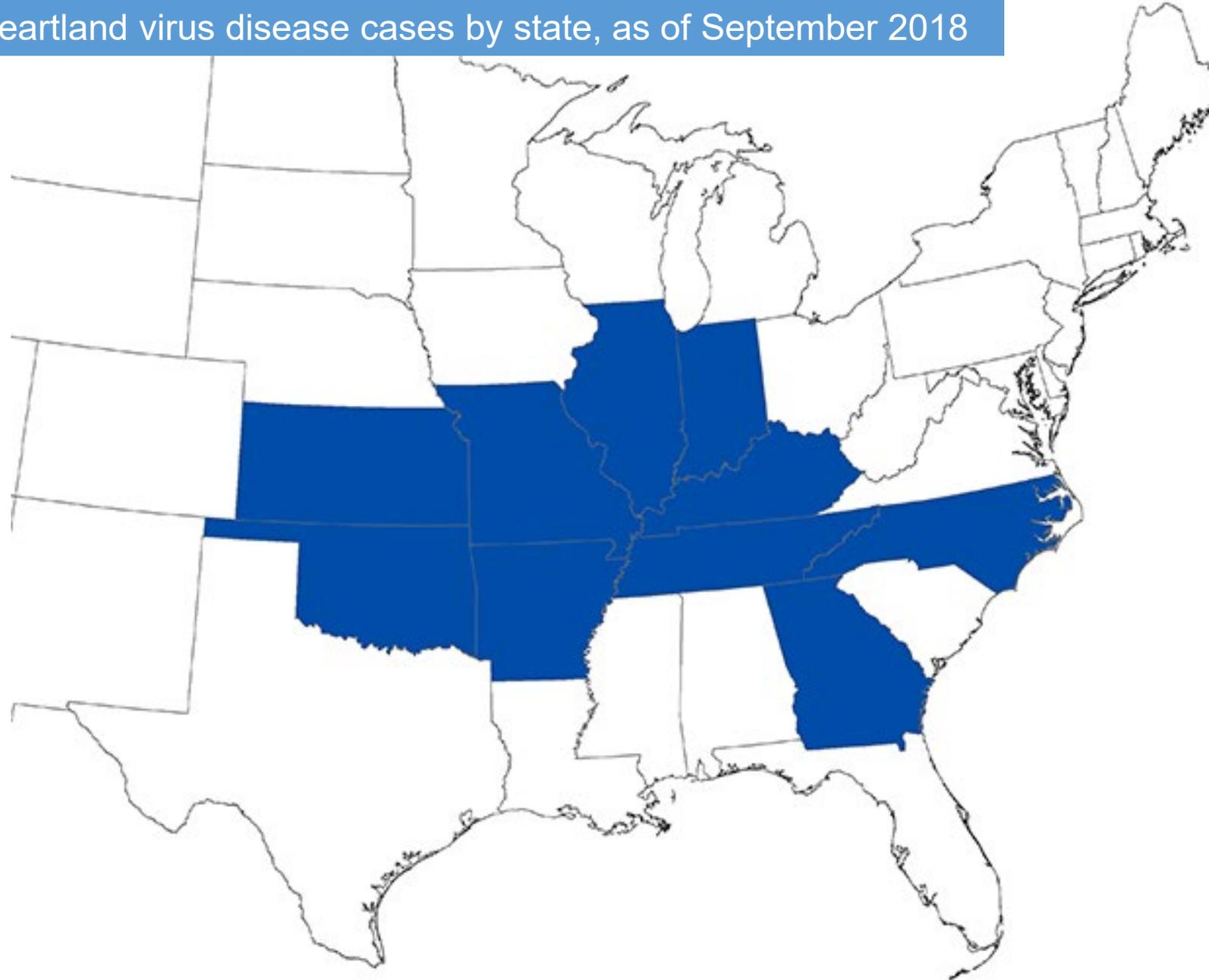
Contact health department
for patients with suspected
tick-borne disease non-
responsive to doxycycline

No routine testing available

Heartland virus disease cases by state, as of September 2018

Heartland Virus Epidemiology

First isolated from 3
Missouri farmers
hospitalized for fever,
thrombocytopenia and
leukopenia in 2009.

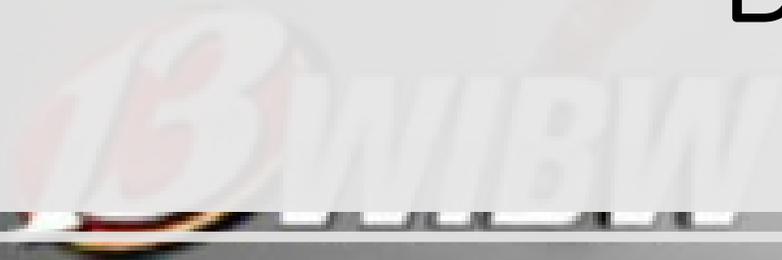




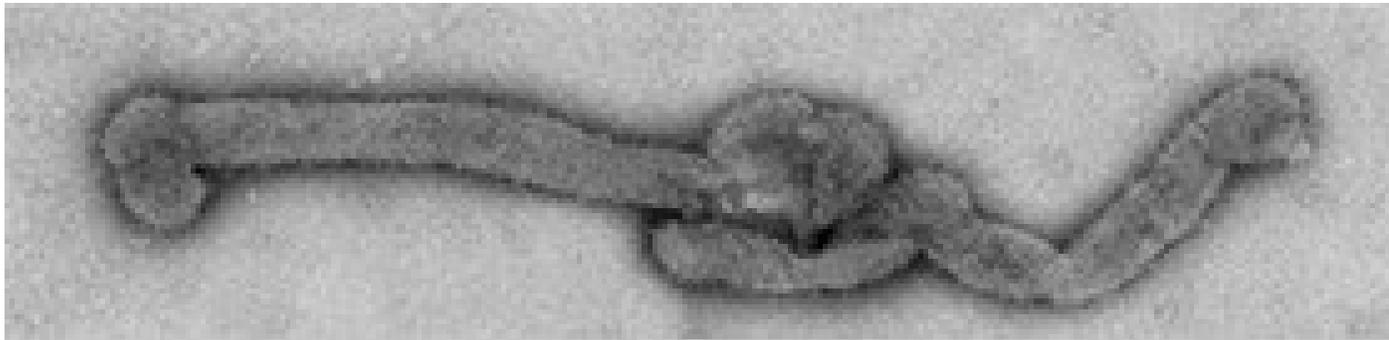
New Virus Found After Kansas Death

Bourbon Virus

A Novel Thogotovirus



Bourbon Virus Symptoms



- Symptoms included fever, fatigue, anorexia, maculopapular rash, headache, nausea, vomiting, thrombocytopenia, & leukopenia
- No routine testing available. Contact health department for patients with suspected tick-borne illness non-responsive to doxycycline.

BOURBON VIRUS



- Thogotovirus identified in single fatal case from eastern Kansas in 2014.
- Vector undetermined, but likely to be tick or other arthropod based on biology of similar viruses

Bourbon Virus

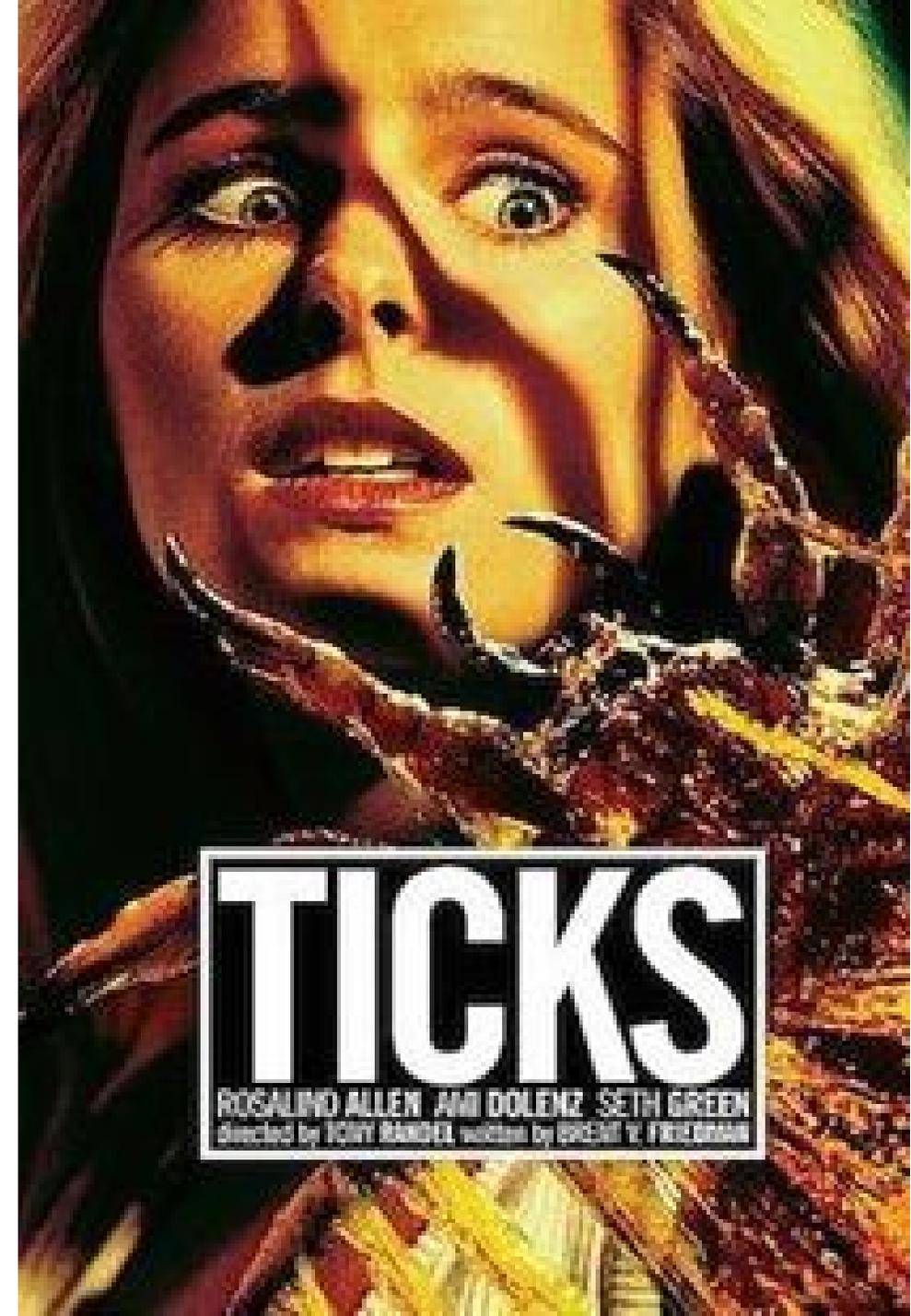
A bloodsucking
'kissing bug' was
found in
Delaware.
Beware its poop

WARNING



Acknowledgements

- Centers for Disease Control and Prevention
- New York State Department of Health
- Dutchess County Department of Behavioral and Community Health



Thank You for Your Attention

- Andrew Sherman Evans Jr., MPH
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