

Vector-Borne Diseases

A guide for healthcare providers

Leslie Ayuk-Takor, MSc.

Epidemiologist

Center for Policy, Planning, and Evaluation | June 7, 2023

AGENDA

- ▶ Online Reporting
- ▶ Overview
 - Tick-borne Diseases
 - Mosquito-borne Diseases
- ▶ Case Study: atypical disease presentation
- ▶ Testing
- ▶ Q&A

Reporting

- Provider Portal
- The online system for all reportable diseases can be accessed on our Infectious Diseases page:

<https://dchealth.dc.gov/infectiousdisease>

- All other notifiable diseases and conditions should be reported to the DC Health Division of Epidemiology-Disease Surveillance and Investigation (DE-DSI) electronically using DC Reporting and Surveillance Center (DCRC), our online reporting system.

▶ Submit a COVID-19 Reporting Form by visiting the [COVID-19 Reporting Requirements](#) page

▶ Submit a [Notifiable Disease and Condition Case Report Form](#) ^{PDF} online using DCRC

▶ Submit a [Zika Test Request and Reporting Form](#) online using DCRC

▶ Submit an [Animal Bite Report Form](#) online using DCRC

▶ Submit a [COVID-19 related Death](#)

Note: The electronic DCRC Notifiable Disease and Condition Case Report Form replaces the [Communicable Disease Case Report Form \[PDF\]](#), a paper form that was previously used to report cases to DE-DSI.

Additional Information for Healthcare Providers

- [Health Notices](#) - DE-DSI shares important information and updates on diseases and issues of public health significance in these notices

Tick-borne Diseases

Reportable in DC

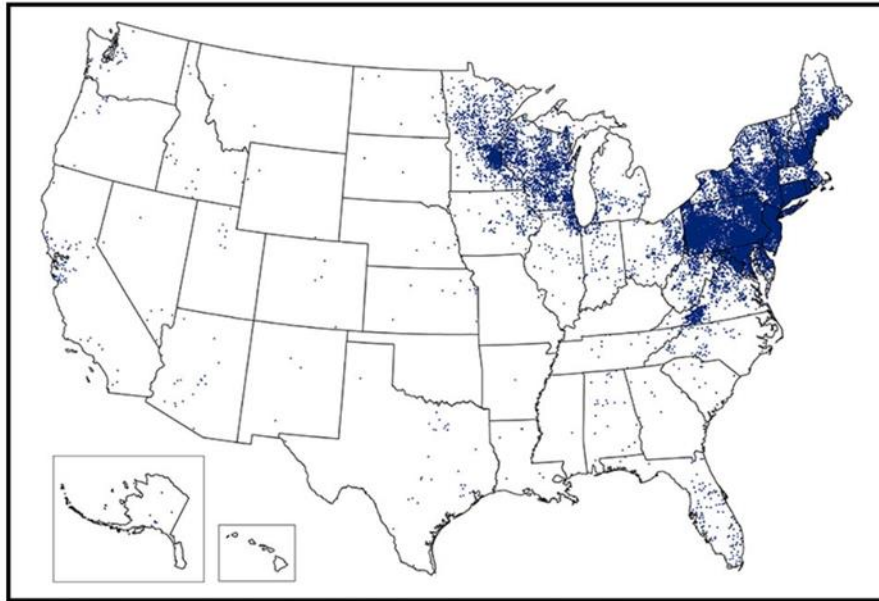
- Anaplasmosis
- Babesiosis
- *Borrelia miyamotoi*
- Colorado tick fever
- Ehrlichiosis
- Heartland virus
- Lyme disease
- Powassan virus
- Spotted Fever Rickettsiosis (including *Rickettsia parkeri* rickettsiosis)
- Rocky Mountain Spotted Fever (RMSF)
- Southern Tick-Associated Rash Illness (STARI)
- Tularemia

Lyme Disease

National Trends

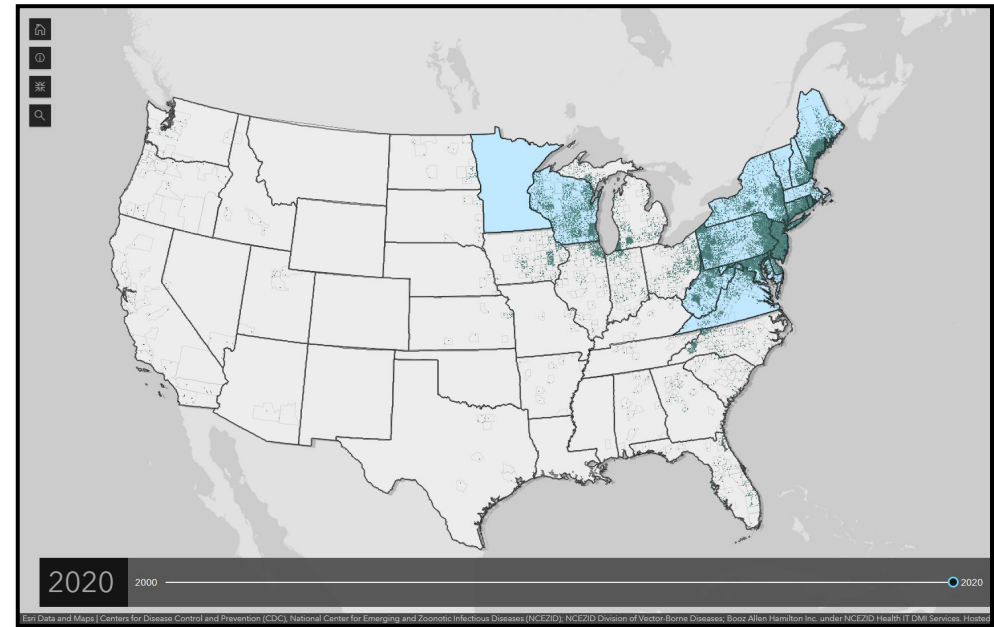
- Endemic in the DMV
- High-incidence jurisdictions

Reported Cases of Lyme Disease — United States, 2017



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

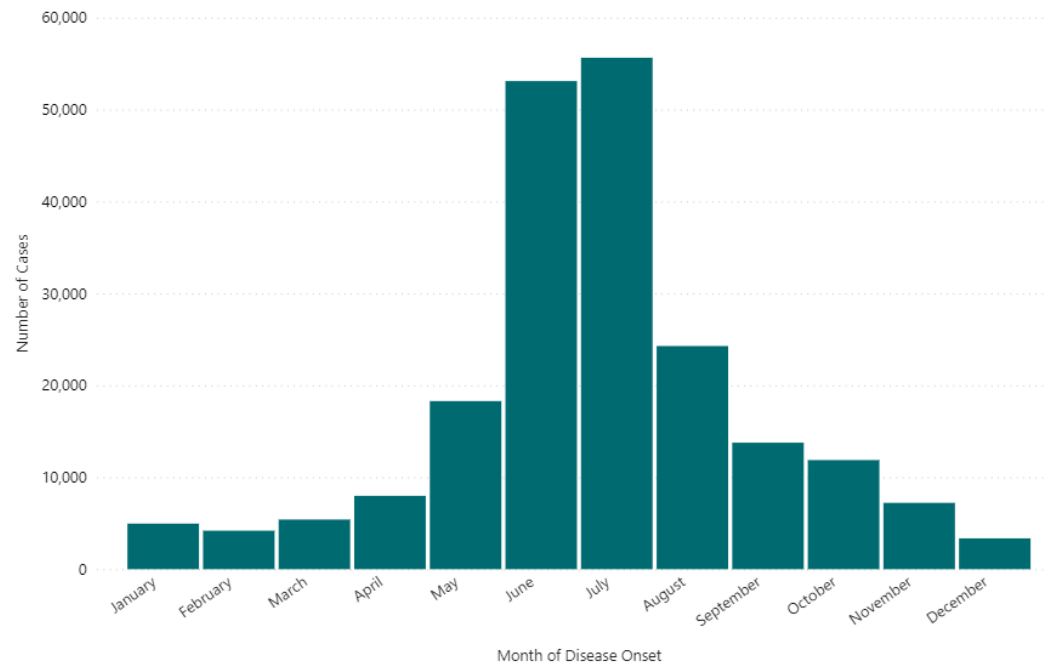
Reported Cases of Lyme Disease – United States, 2020



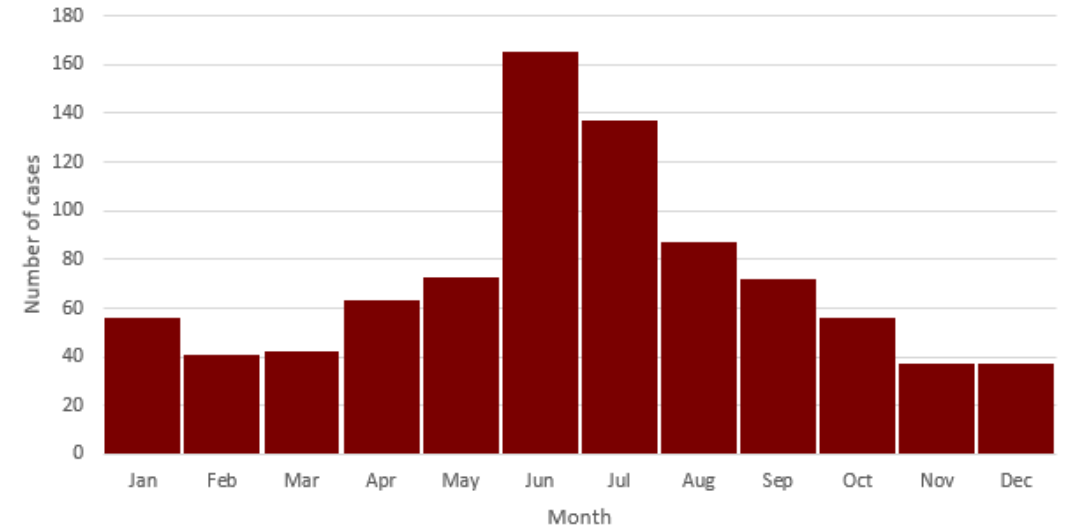
Lyme Disease

Seasonal Trends

Lyme Disease – Cases by Month of Disease Onset, United States, 2012-2020

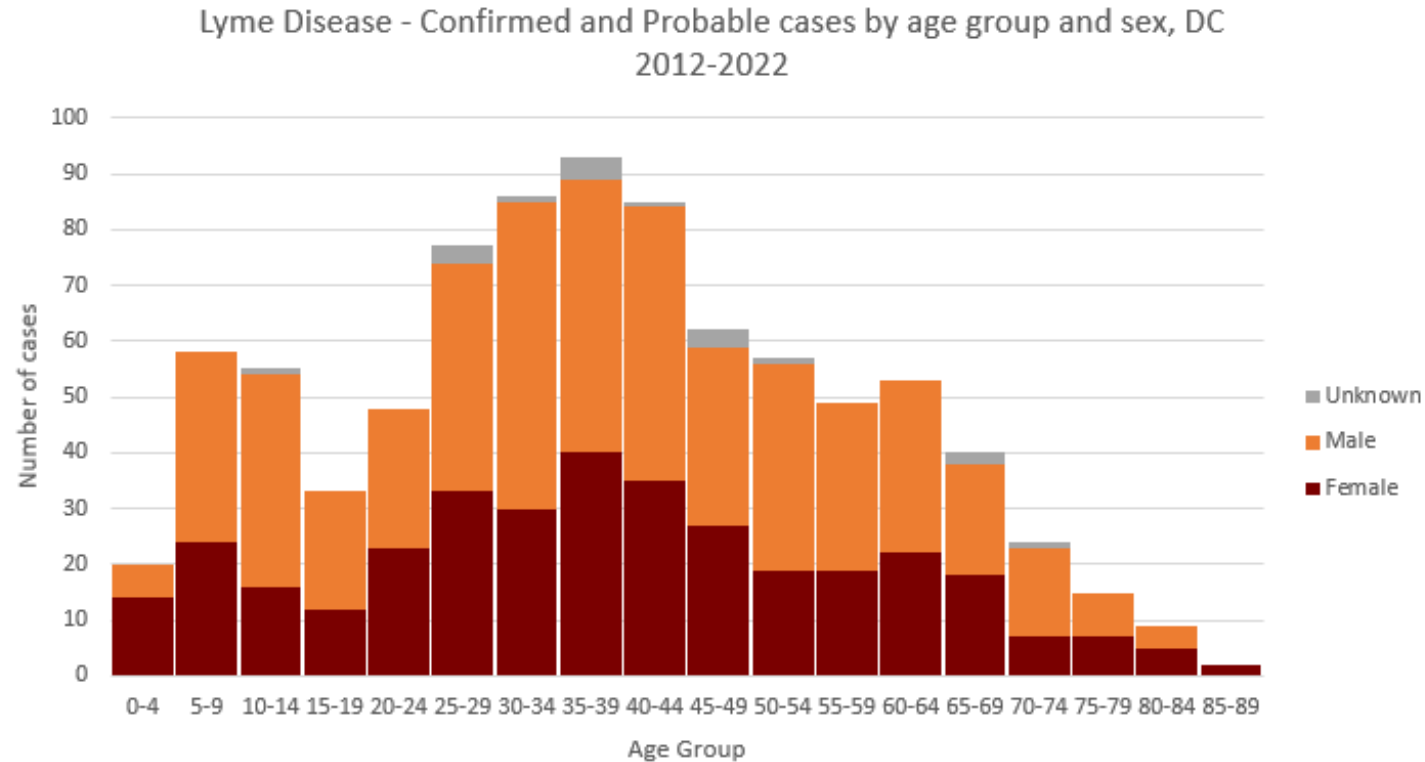


Lyme Disease - Confirmed and Probable cases by month, DC
2012-2022



Lyme Disease

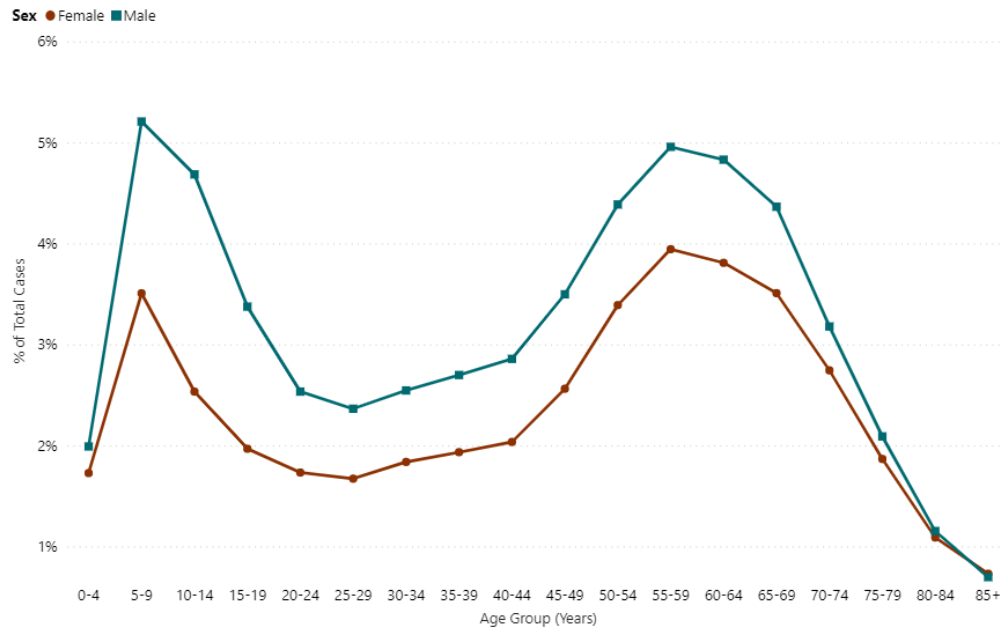
Age and Sex Distribution



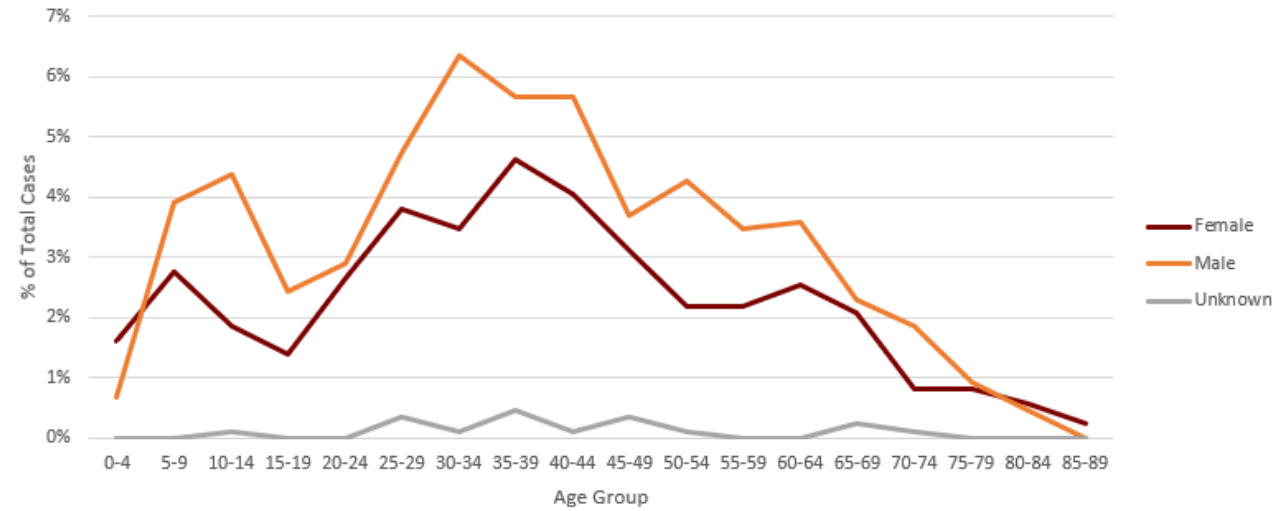
Lyme Disease

Age Distribution

Lyme Disease – Percent of Total Cases by Age Group and Year - United States, 2012-2020



Lyme Disease - Percent of Total Confirmed and Probable Cases by Age Group and Sex, DC 2012-2022



Lyme Disease

Erythema migrans (EM) rash

- ~70-80% of infected persons
- ~3-30 days (7 average) after tick bite
- Expands gradually over several days
- Not always “classic” appearance



Source: https://www.cdc.gov/lyme/signs_symptoms/index.html

Erythema Migrans (EM) Rash



Lyme Disease

Serologic Testing

- Standard two-tier test (STTT)
 - 1 IgM/IgG/IgM+IgG EIA (enzyme immunoassay) or IFA (immunofluorescence assay)
 - 2 IgM/IgG Immunoblot (Western blot)

POSITIVE = positive or equivocal 1 + positive 2
- Modified two-tier test (MTTT)*
 - 1 IgM+IgG EIA or IFA
 - 2 IgM/IgG/IgM+IgG EIA or IFA

POSITIVE = positive or equivocal 1 + positive or equivocal 2

*Only assays specifically cleared by the FDA for this purpose should be used

Lyme Disease

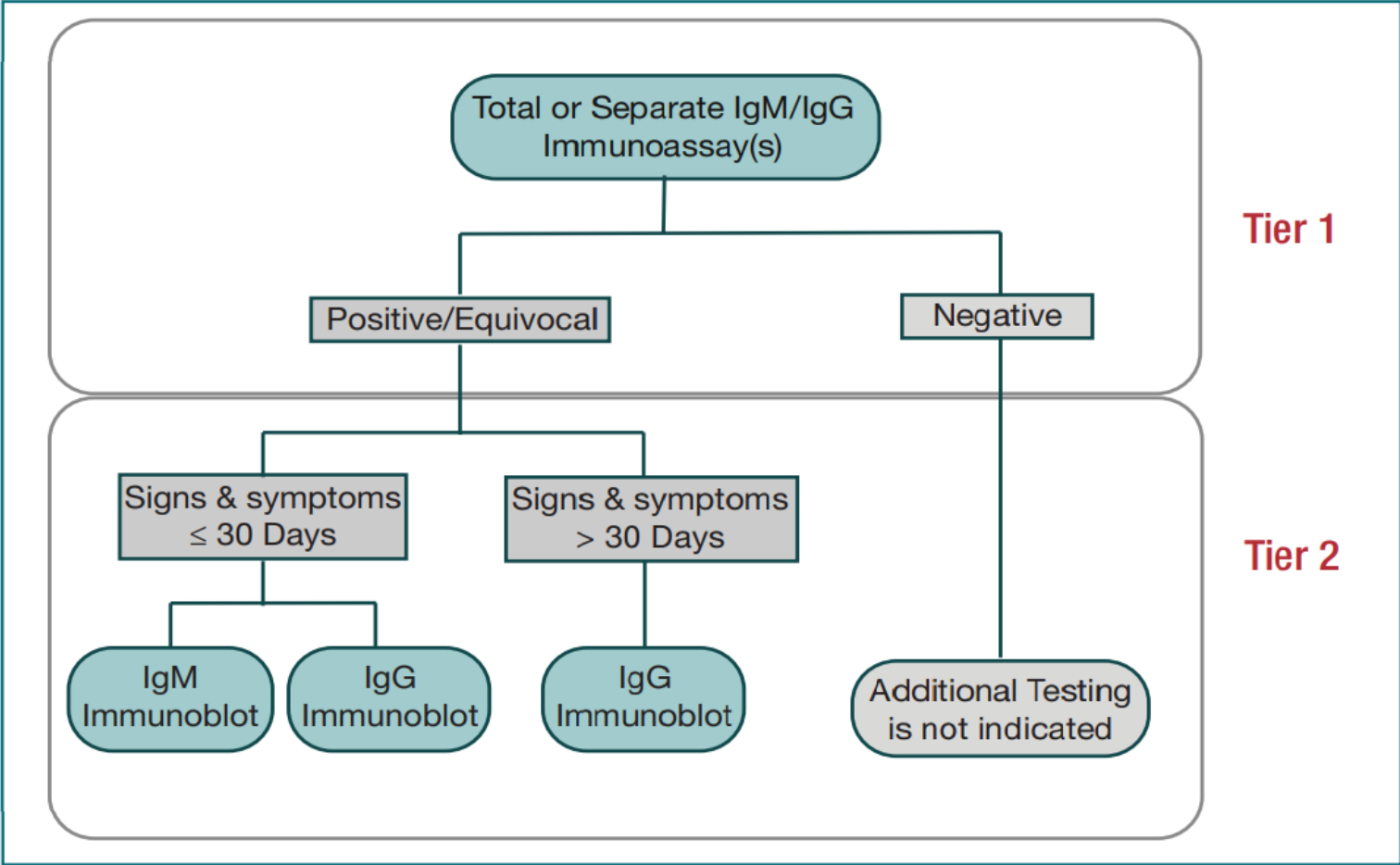
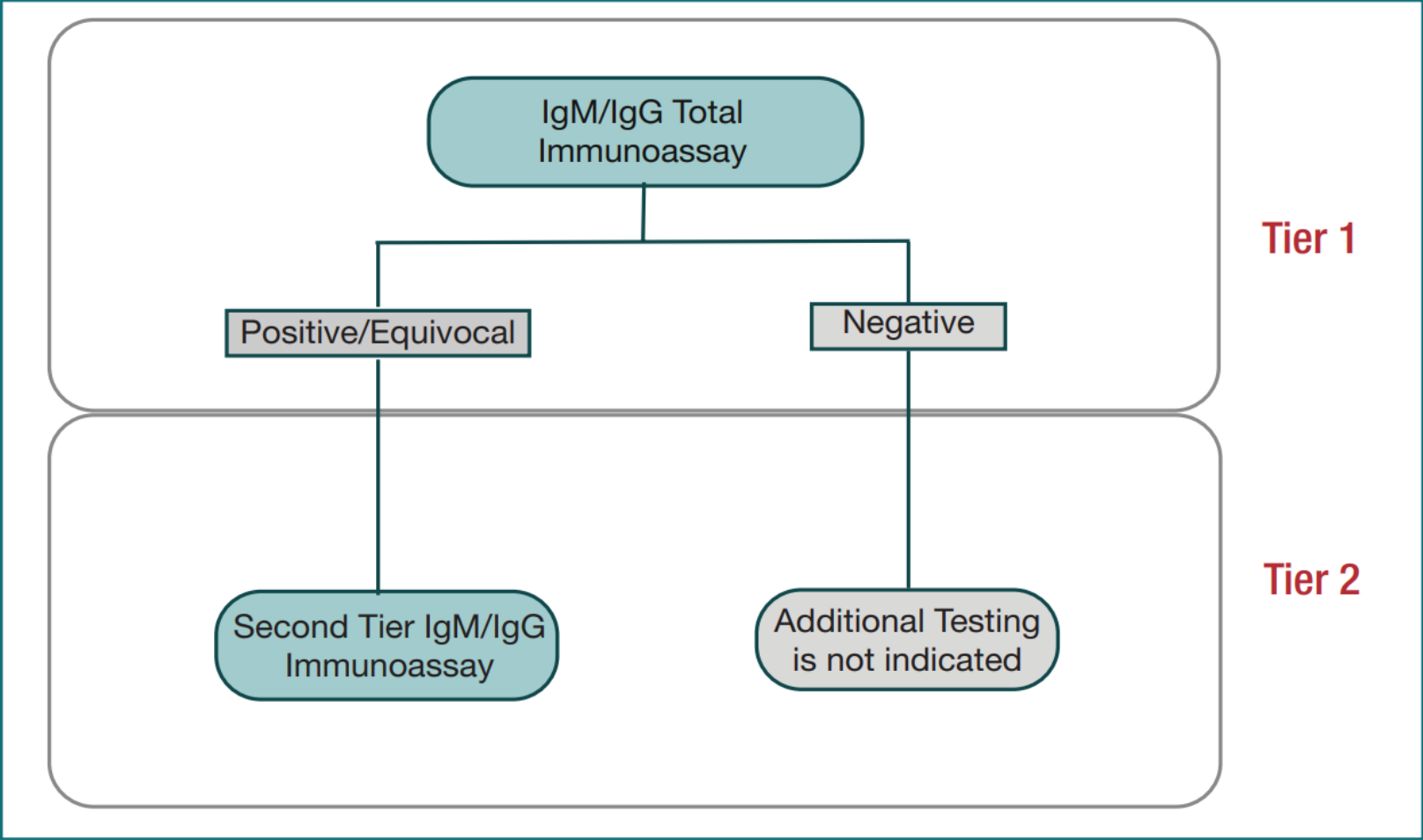


Figure 1: Standard Two-Tiered Testing (STTT)

Source: <https://www.aphl.org/aboutAPHL/publications/Documents/ID-2021-Lyme-Disease-Serologic-Testing-Reporting.pdf>

Lyme Disease

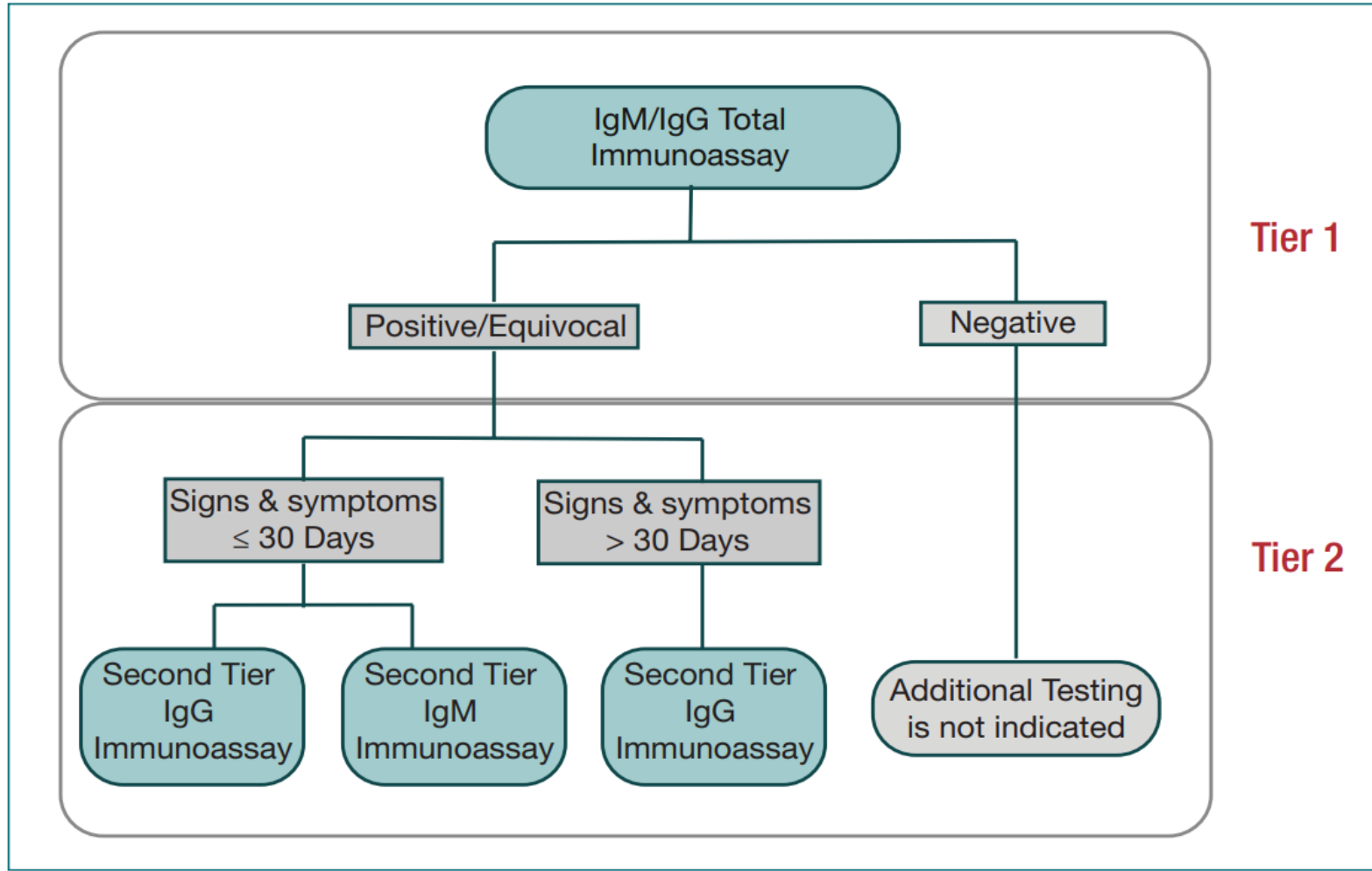
Figure 2: Modified Two-Tiered Testing (MTTT) 1 – Two Total IgM/IgG immunoassay



Source: <https://www.aphl.org/aboutAPHL/publications/Documents/ID-2021-Lyme-Disease-Serologic-Testing-Reporting.pdf>

Lyme Disease

Figure 3: Modified Two-Tiered Testing Algorithm (MTTT) 2 – Separate IgM and IgG Second Tier immunoassays



Source: <https://www.aphl.org/aboutAPHL/publications/Documents/ID-2021-Lyme-Disease-Serologic-Testing-Reporting.pdf>

Lyme Disease

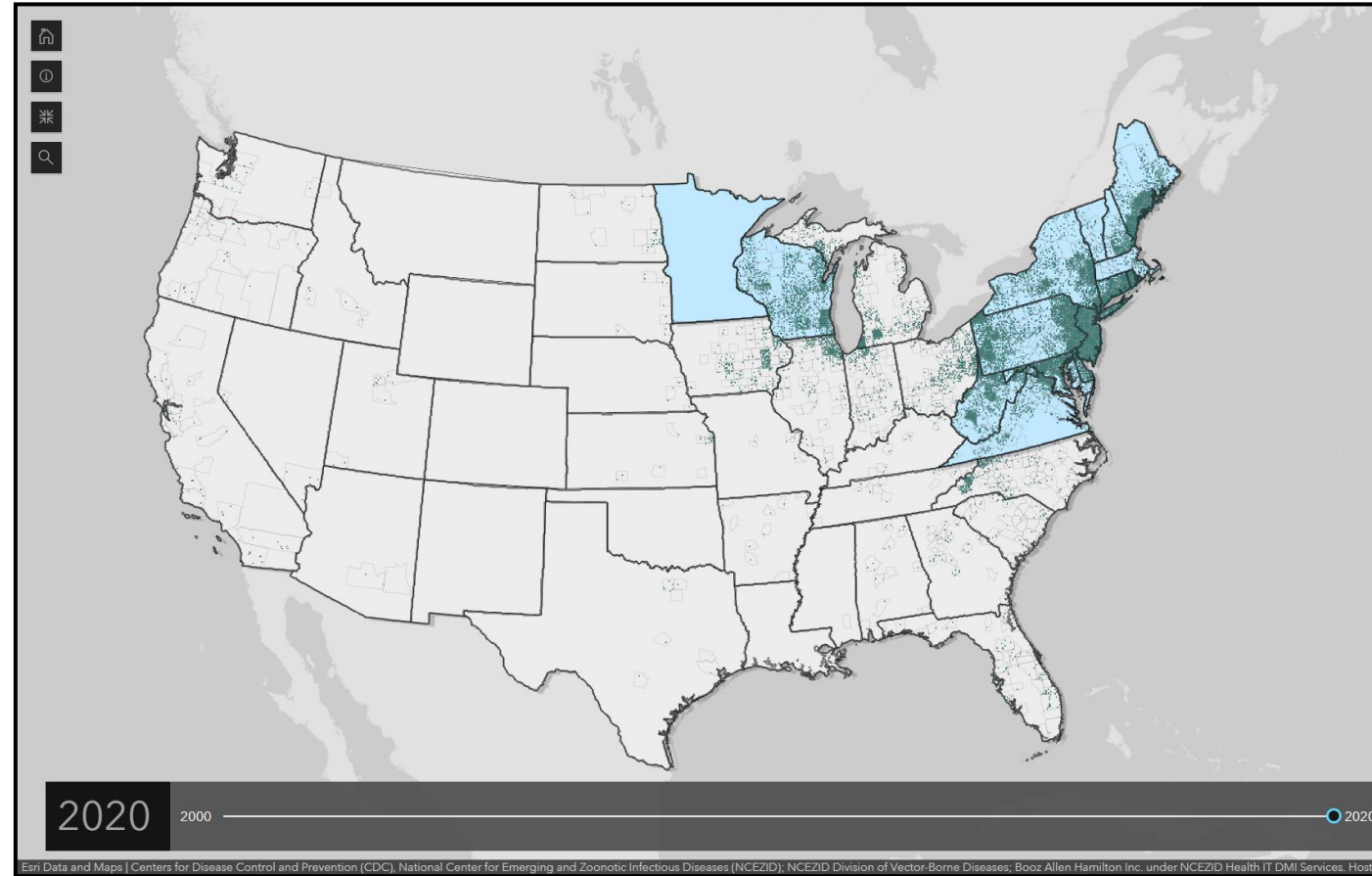
Case Classification

- New CDC case definition
- Clinical symptoms (e.g., presence of EM rash) are no longer factors for case classification in DC
- Possible classifications:
 - Not a case
 - Suspect
 - Probable

The screenshot displays the NNDSS website interface. At the top, a blue header reads "National Notifiable Diseases Surveillance System (NNDSS)". Below this, a breadcrumb trail shows "CDC > NNDSS > Surveillance Case Definitions > Lyme disease". A left-hand navigation menu includes links for "NNDSS", "What is Case Surveillance?", "Case Surveillance Modernization", "Case Surveillance in Action", "Data and Statistics", "Case Definitions" (which is highlighted), "Technical Resource Center", and "Contact". The main content area is titled "Lyme Disease (*Borrelia burgdorferi*) 2022 Case Definition" and includes a "Print" link. A yellow-highlighted "NOTE" states: "A surveillance case definition is a set of uniform criteria used to define a disease for public health surveillance. Surveillance case definitions enable public health officials to classify and count cases consistently across reporting jurisdictions. Surveillance case definitions are not intended to be used by healthcare providers for making a clinical diagnosis or determining how to meet an individual patient's health needs." Below the note, the text "CSTE Position Statement(s)" is followed by the identifier "21-ID-05".

Lyme Disease

- High-incidence jurisdictions



Tick-borne Rickettsial Diseases

Selected Clinical Features

Disease	Incubation period	Common initial signs and symptoms	Cutaneous signs	Common laboratory findings	Estimated case-fatality rate
Rocky Mountain spotted fever	3-12 days	Fever, headache, chills, malaise, myalgia, nausea, vomiting, abdominal pain, photophobia, anorexia	Maculopapular rash approximately 2-4 days after fever onset in most, might become petechial and involve palms and soles	Thrombocytopenia, slightly increased hepatic transaminase levels, normal or slightly increased white blood cell count with increased immature neutrophils, hyponatremia	5%-10%
<i>Rickettsia parkeri</i> rickettsiosis	2-10 days	Fever, myalgia, headache	Eschar, sparse maculopapular or vesiculopapular rash that might involve palms and soles	Mild thrombocytopenia, mild leukopenia, increased hepatic transaminase levels	—*
<i>Rickettsia</i> species 364D rickettsiosis	— [†]	Fever, headache, myalgia, fatigue	Eschar or ulcerative lesion with regional lymphadenopathy	— [†]	—*
<i>Ehrlichia chaffeensis</i> ehrlichiosis (human monocytic ehrlichiosis)	5-14 days	Fever, headache, malaise, myalgia, nausea, diarrhea, vomiting	Rash in approximately 30% of adults and 60% of children, variable rash pattern that might involve palms and soles, appears a median of 5 days after illness onset	Leukopenia, thrombocytopenia, increased hepatic transaminase levels, hyponatremia, anemia	3%
<i>Ehrlichia ewingii</i> ehrlichiosis	— [†]	Fever, headache, malaise, myalgia	Rash rare	Leukopenia, thrombocytopenia, increased hepatic transaminase levels	—*
<i>Ehrlichia muris</i> -like agent ehrlichiosis	— [†]	Fever, headache, malaise, myalgia	Rash in approximately 12%	Thrombocytopenia, lymphopenia, leukopenia, increased hepatic transaminase levels, anemia	—*
Human anaplasmosis (human granulocytic anaplasmosis)	5-14 days	Fever, headache, malaise, myalgia, chills	Rash rare, in <10%	Thrombocytopenia, leukopenia, mild anemia, increased hepatic transaminase levels, increased numbers of immature neutrophils	<1%

*No known deaths.

[†]Not documented.

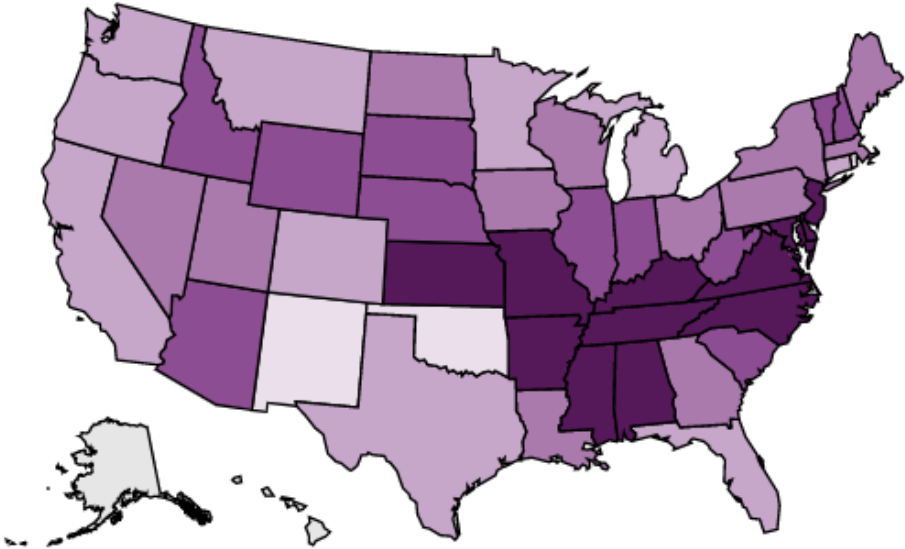
Spotted Fever Rickettsioses

Tick-borne Spotted Fever Group Rickettsioses (SFGR)

- Rocky Mountain Spotted Fever, caused by *Rickettsia rickettsii* (ticks)
- Rickettsia parkeri rickettsiosis, caused by *R. parkeri* (ticks)
- Pacific Coast tick fever, caused by Rickettsia species 364D—now *R. philipii* (ticks)

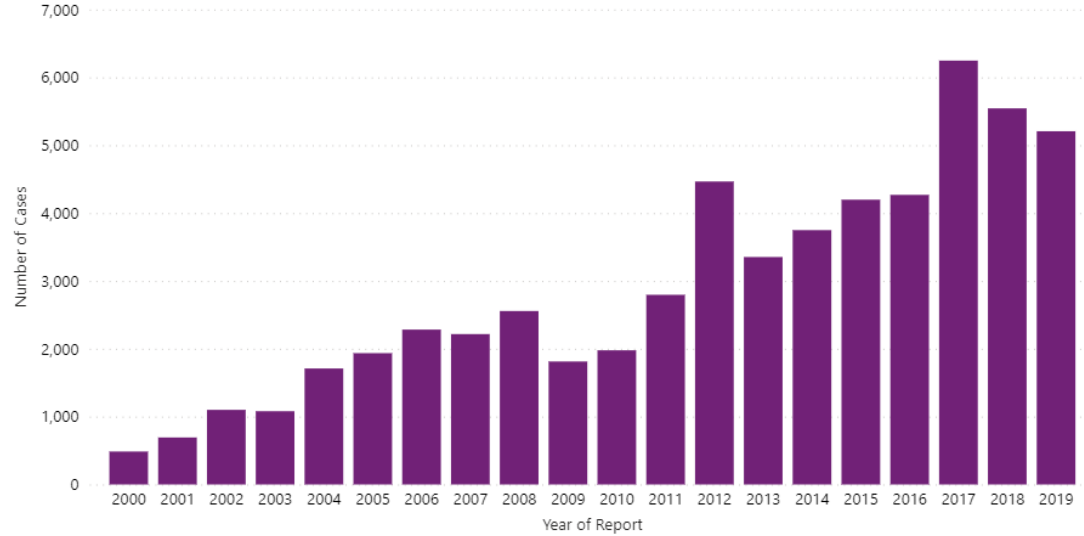
Annual incidence (per million population) of reported spotted fever rickettsiosis—United States for 2019

0 0 to < 1.87 1.87 to < 5.24 5.24 to < 14.93 14.93+ Not Notifiable

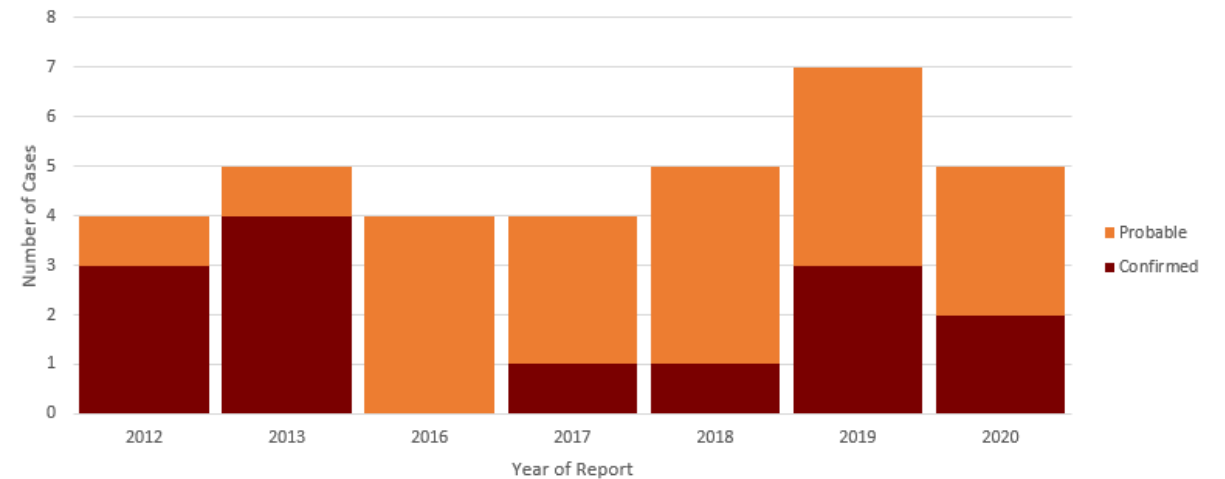


Spotted Fever Rickettsioses

Number of reported cases of spotted fever rickettsiosis –United States, 2000–2019



Spotted Fever Rickettsioses - Total Confirmed and Probable Cases by Year, DC 2012-2022



Rocky Mountain Spotted Fever

Distribution of vectors

- Common vectors:
 - *Dermacentor variabilis* (American dog tick)
 - *Dermacentor andersoni* (Rocky Mountain wood tick)
 - *Rhipicephalus sanguineus* (Brown dog tick)
- RMSF most commonly transmitted by American dog tick (*Dermacentor variabilis*) in eastern, central, western US
- Exposure is defined as having been in potential tick habitats within the past 14 days before onset of symptoms. Recent travel history should be considered.



Rocky Mountain Spotted Fever

- Rapidly progressive, can be fatal within days
- Rash is a common sign, typically 2-4 days after fever
- Long-term health problems
- Risk factors for severe illness
 - Delayed treatment
 - Children < 10 years
 - Persons with glucose-6-phosphate dehydrogenase (G6PD) deficiency
- Always take thorough patient history
- Serologic testing
- Report all cases of Spotted Fever Rickettsioses to DC Health within 48 hours of provisional diagnosis or appearance of suspicious symptoms



Resources

- DC Health
 - Tickborne Diseases: <https://dchealth.dc.gov/page/tickborne-diseases>
 - Lyme Disease: <https://dchealth.dc.gov/page/lyme-disease>
- CDC
 - Tickborne Rickettsial Disease guide for healthcare and public health professionals: <https://www.cdc.gov/mmwr/volumes/65/rr/pdfs/rr6502.pdf>
 - Rocky Mountain Spotted Fever (and other tickborne diseases) Toolkit for Healthcare Providers: <https://www.cdc.gov/rmsf/resources/toolkit.html>
- Association of Public Health Laboratories
 - Suggested Reporting Language, Interpretation and Guidance Regarding Lyme Disease Serologic Test Results: <https://www.aphl.org/aboutAPHL/publications/Documents/ID-2021-Lyme-Disease-Serologic-Testing-Reporting.pdf>

Mosquito-borne Diseases

Reportable in DC

- Cache Valley virus
- Chikungunya virus
- Dengue virus
- Eastern Equine Encephalitis
- Jamestown Canyon virus
- Japanese Encephalitis
- LaCrosse virus
- Malaria
- Saint Louis Encephalitis
- Venezuelan Equine Encephalitis
- West Nile virus
- Western Equine Encephalitis
- Yellow fever
- Zika virus

Please report all cases, including endemic (i.e. West Nile Virus) and imported diseases (i.e. Chikungunya, Dengue, Zika)

For more information, email: vectorborne.epi@dc.gov

Mosquito-borne Disease Vectors



Aedes aegypti

Chikungunya virus
Dengue Fever virus
Saint Louis Encephalitis
West Nile Virus
Yellow Fever virus
Zika Virus



Culex pipiens

Eastern Equine Encephalitis
Japanese Encephalitis
Saint Louis Encephalitis
West Nile Virus



Aedes albopictus

Chikungunya virus
Dengue Fever virus
Saint Louis Encephalitis
West Nile Virus
Yellow Fever virus
Zika Virus

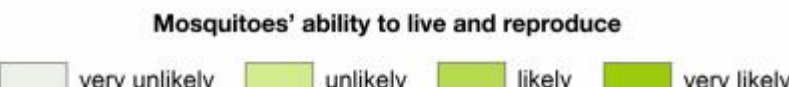
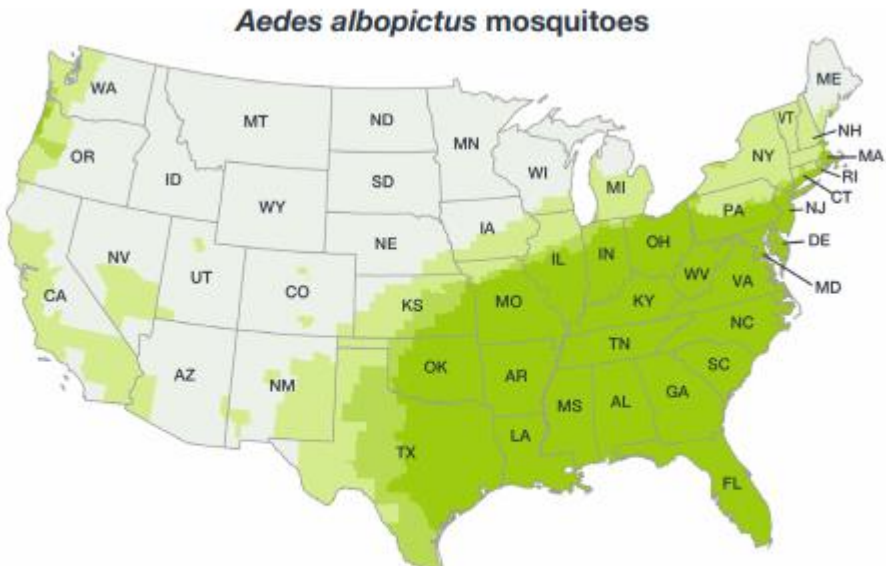
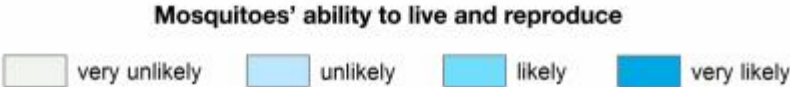
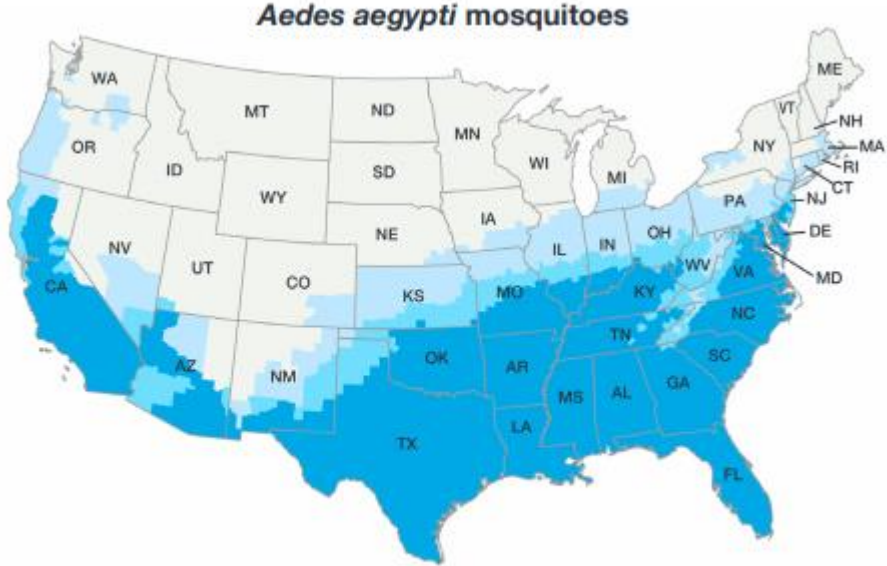


Anopheles

Malaria

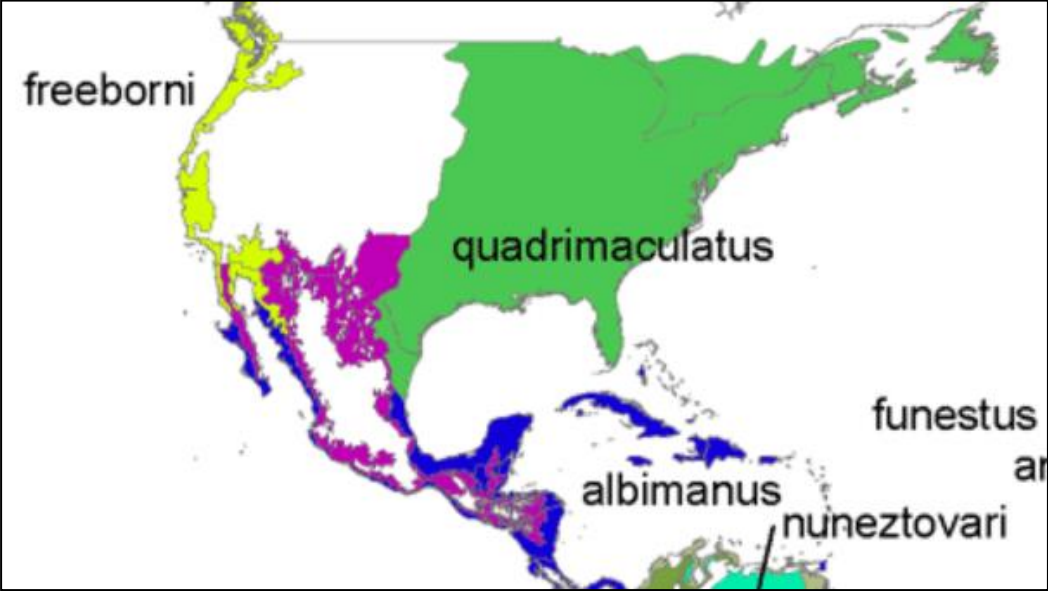
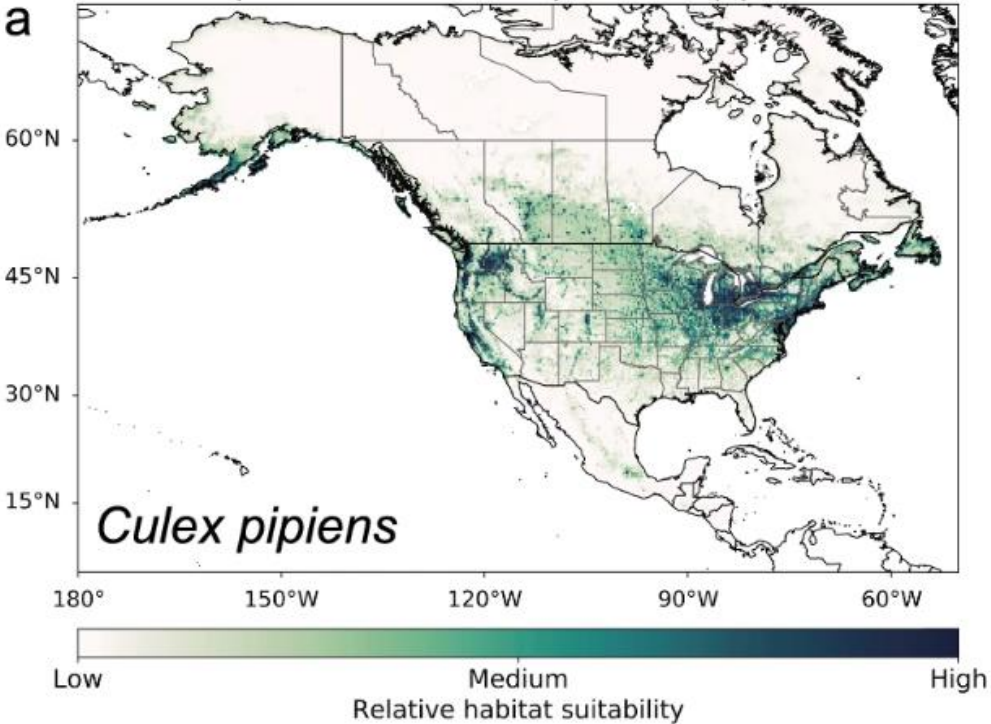
Mosquito-borne Diseases

Vector distribution



Mosquito-borne Diseases

Vector distribution



Anopheles species distribution US

Mosquito-borne Diseases

Selected Clinical Features

		Chikungunya	Dengue	Malaria	West Nile	Yellow Fever	Zika
average time from exposure to development of symptoms		3 to 7 days <i>(range: 1 to 12 days)</i>	4 to 10 days <i>(range: 3 to 10 days)</i>	≥14 days <i>(range: 7 days to several months)</i>	2 to 6 days <i>(range: 2 to 14 days)</i>	3 to 6 days	3 to 14 days
common symptoms	fever	✓	✓	✓	✓	✓	✓
	headache	✓	✓	✓	✓	✓	✓
	body/muscle aches	✓	✓	✓	✓	✓	✓
	chills	✓	-	✓	-	✓	-
	eye pain	-	✓	-	-	-	✓
	conjunctivitis	✓	-	-	-	-	✓
	joint pain	✓	✓	-	✓	-	✓
	nausea/vomiting	-	✓	✓	✓	✓	-
	rash	✓	✓	-	✓	-	✓
unique symptoms	severe joint pain and/or swelling	low white blood cell count bleeding manifestations vascular leakage and shock [‡]	waxing/waning fever and chills	meningitis, encephalitis, myelitis	red eyes, face or tongue hepatitis/jaundice	congenital Zika syndrome	

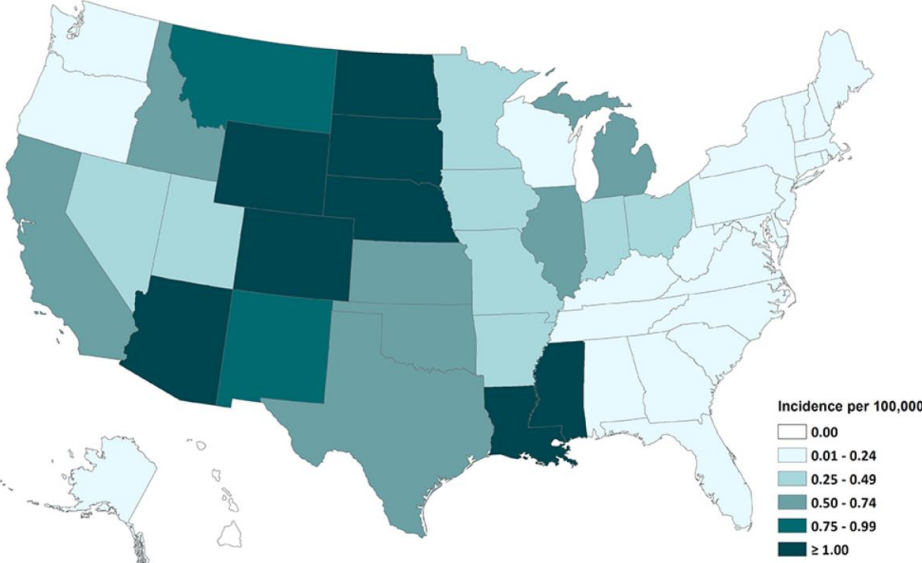
[‡]*if exposed to two different serotypes*

Mosquito-borne Diseases

West Nile Virus

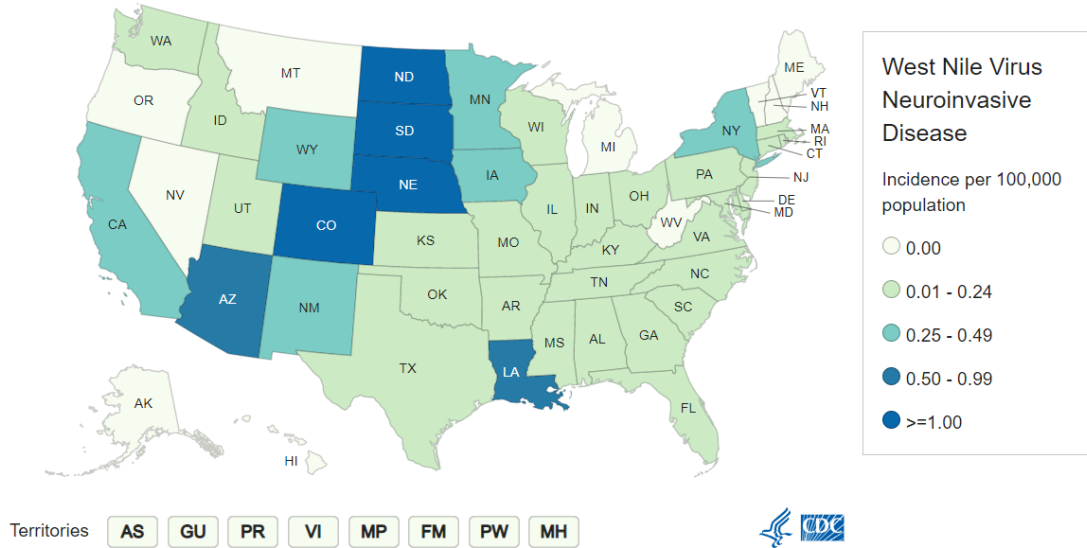
- Endemic in DC since 2002
- Reportable in DC

Average annual incidence of West Nile virus neuroinvasive disease reported to CDC by state, 1999-2021



Source: ArboNET, Arboviral Diseases Branch, Centers for Disease Control and Prevention

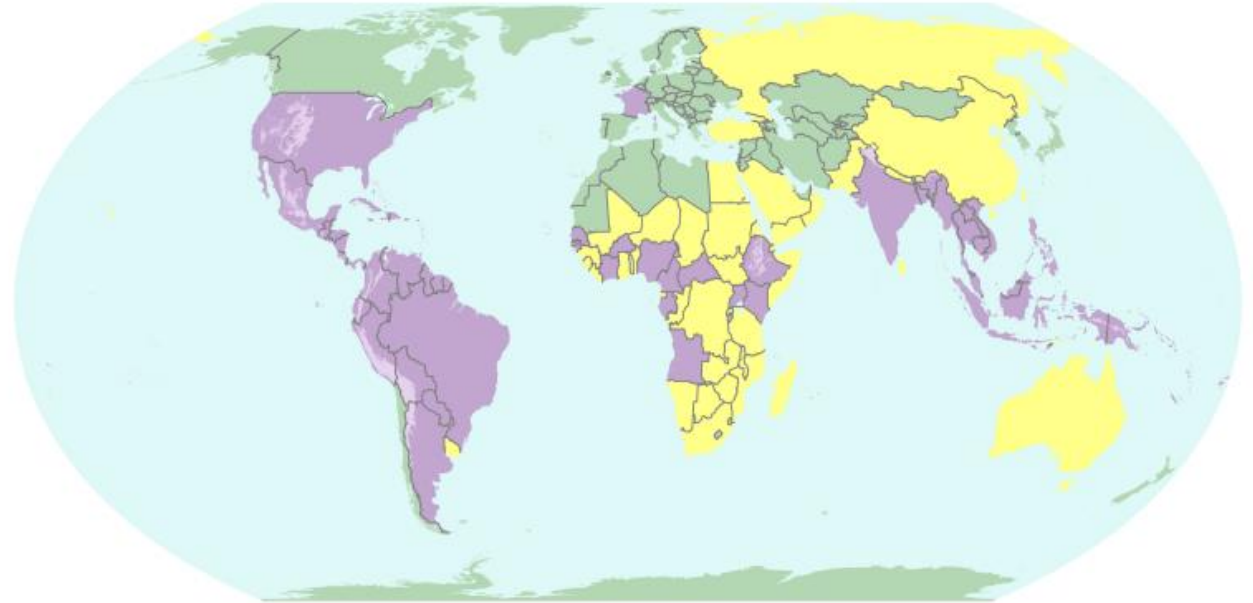
West Nile Virus Neuroinvasive Disease Incidence by State 2022 (preliminary map)








Mosquito-borne Diseases

Zika Virus

- No current local transmission in the continental United States
- No confirmed Zika virus cases reported from United States territories since 2019
- Travel history is very important
- Reportable in DC



Map Legend

- | | |
|--|--|
|  Country or territory with current Zika outbreak ¹ |  Country or territory with mosquito ³ but no reported Zika cases |
|  Country or territory that has ever reported Zika cases ² (past or current) |  Country or territory with no mosquitoes that spread Zika |
|  Areas with low likelihood of Zika infection because of high elevation (above 6,500ft/2,000m) | ¹ No areas are currently reporting Zika outbreaks |
| | ² Locally acquired, mosquito-borne Zika cases |
| | ³ <i>Aedes aegypti</i> |

Atypical Presentation of Disease

Recrudescent Malaria

Initial Infection

- Traveled to Ghana from 12/7 – 12/10
- Symptom onset: ~12/22/2022
- Test positive: 12/29/2022 at 11.36% parasitemia (*P. falciparum*)
- Treatment: IV Artesunate (3) followed by Coartem (1)
- Discharged: 1/1/2023 at 0% parasitemia

Return to hospital

The patient returned to the hospital on 1/10 with complaints of headache, fatigue, shortness of breath, dry cough, palpitations, and tachycardia to the 120s. Malaria smears were negative. Concluded to be delayed hemolytic anemia presumably due to IV artesunate (hgb of 5). Discharged 1/13. Symptom resolution.

Recrudescent Infection

- Symptom onset: 1/22/2023 (New fever, chills, vomiting, nausea, diarrhea and extreme fatigue)
- Test positive: 1/24/2023 at 2.5% parasitemia (*P. falciparum*)
- Treatment: Malarone (3)
- Discharged: 1/27/2023 at 0% parasitemia
- No travel between illness
- Potential suboptimal absorption of oral Coartem due to patient's nausea & vomiting

Atypical Presentation of Disease

Recrudescent Malaria

- Monitor patients for indications of suboptimal absorption of treatment
- Save whole blood specimen for further testing
 - Gametocytes may be present after treatment
 - Do not cause acute illness, but can make smear interpretation difficult
 - Molecular resistance testing at CDC
 - Could impact treatment and prophylaxis guidelines
- Prompt treatment is critical
- Notify DC Health immediately

Reminder: Online Reporting

- The online system for all reportable diseases can be accessed on our Infectious Diseases page: <https://dchealth.dc.gov/infectiousdisease>
- Please share as much information as possible
 - Exposures
 - Hospitalization history
 - Travel history
 - All related test results
 - Treatment
- Don't hesitate to contact us with any questions
 - vectorborne.epi@dc.gov
 - leslie.ayuk-takor@dc.gov



Reminder: Testing

- First line testing should be performed at your facility or a commercial laboratory
- Only confirmatory testing is available through the DC Public Health Lab (DC PHL)
 - For specialized tests available through CDC
 - For tests not available commercially
- Testing at DC PHL and CDC needs **pre-approval** from DC Health
 - Submit a case report form **and** contact DC Health directly

Resources for you

- DC Health webpages
- Annual tick-borne and arboviral surveillance reports
- Mosquito surveillance reports
- Vector-borne disease Health Alert Notice (HAN)
- Annual Vector-borne Disease Webinar
- School Outreach
- Animal Disease Surveillance System
 - Lyme Disease in dogs and cats
 - West Nile Virus in dogs, cats, birds
- CDC Division of Vector-Borne Diseases (DVBD)

Questions?

Contacts:

Dr. Anil Mangla, State Epidemiologist
O: 202-442-8141; anil.mangla@dc.gov

Leslie Ayuk-Takor, Epidemiologist
O: 202-442-9143; leslie.ayuk-takor@dc.gov



THANK YOU!


DC | HEALTH

GOVERNMENT OF THE DISTRICT OF COLUMBIA

899 North Capitol Street NE, 5th Fl, Washington, DC 20002

 dchealth.dc.gov

 [@_DCHealth](https://twitter.com/_DCHealth)

 [dchealth](https://www.instagram.com/dchealth)

 [DC Health](https://www.facebook.com/DCHealth)

 [dchealth](https://www.tiktok.com/dchealth)