

## Dengue Surveillance in North Carolina, 2023

Dengue is caused by one of the four closely related dengue viruses. Dengue can lead to severe illness; however, only one in four people infected will develop symptoms.

The dengue virus infects *Aedes* mosquitoes when they bite an infected human. Then, the mosquito can transmit the virus while biting other humans. Dengue does not spread from person to person.

It is possible for local dengue transmission to occur in the United States. However, the primary mosquito that transmits dengue, *Aedes aegypti*, does not live in North Carolina. A similar species, *Aedes albopictus*,

resides in parts of NC and has been documented as able to transmit dengue, although less likely.

To avoid being infected with dengue, take precautions to avoid [mosquito bites](#), especially when traveling internationally to countries with known dengue transmission.

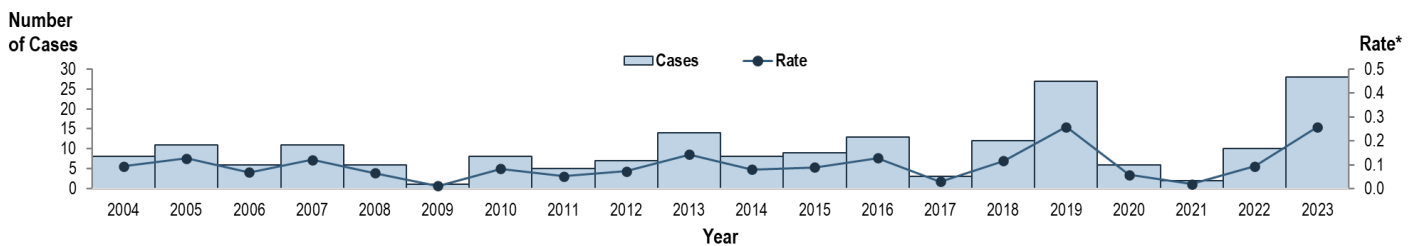
Additional information regarding dengue vectors, transmission, symptomology, and prevention can be found on the [CDC's website](#).

### Dengue Epidemiology

Although dengue cases in North Carolina (NC) have remained relatively low over the last 20-years, 2023 had the highest ever annual count and rate.

**Dengue has historically had low annual counts and rates, but 2023 had the highest annual count and rate to date.**

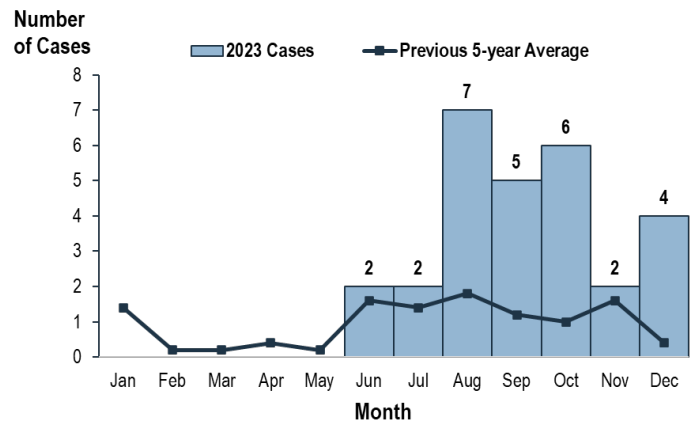
NC 2004-2023 dengue case count and rate by year



In 2023, there were 28 cases of dengue in NC residents, a rate of 0.26 per 100,000 North Carolinians. This is the highest NC has ever seen, 2.4 times higher than the 5-year average rate (2018 to 2022; 0.27 versus 0.11, respectively). Cases were more likely to occur in the summer and fall months (86% of cases between June and November).

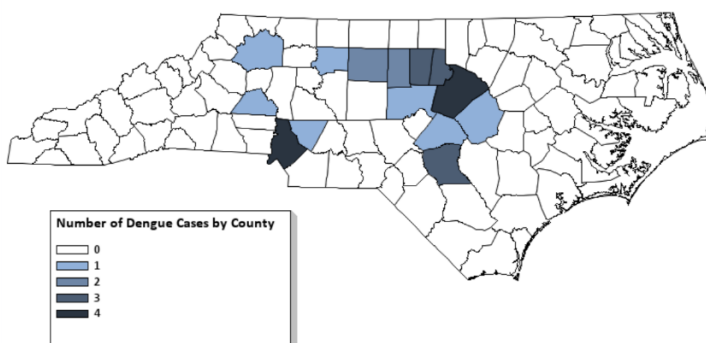
**Dengue seasonality is primarily late summer and early fall.**

NC 2023 dengue cases by month with previous 5-year average\*\* comparison



**Dengue cases occurred in 14 out of 100 counties.**

NC 2023 dengue cases by county

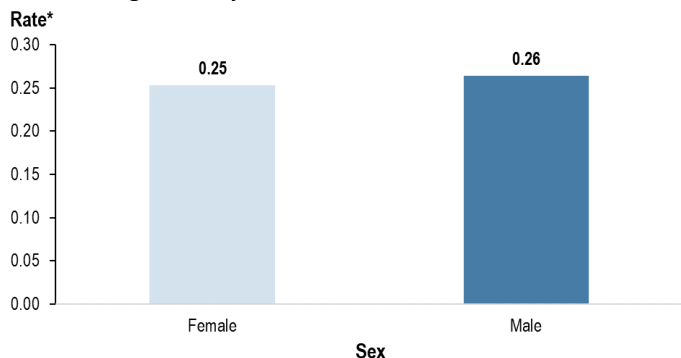


Most 2023 dengue cases reside in the central part of NC. Mecklenburg and Wake County have the highest case counts, which is to be expected given the increased population residing in those counties.

## Dengue Case Demographics

**Dengue rates were similar among male and female North Carolinians.**

NC 2023 dengue rates by sex

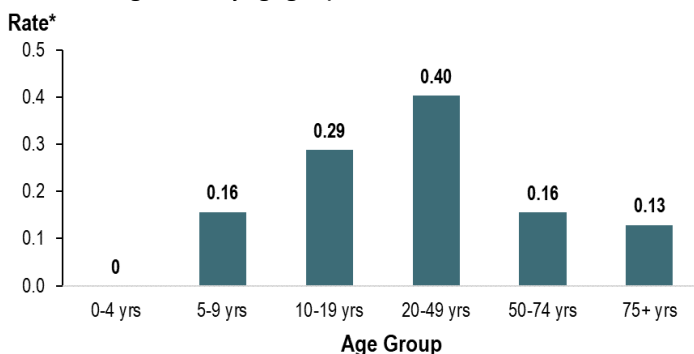


In 2023, 14 (50%) of dengue cases in NC were female and 14 (50%) of cases were male. Rates were almost identical (0.26 per 100,000 in females and 0.25 per 100,000 in males).

Adults 20 to 49 years old had the highest rate of dengue infection in 2023 (0.40 per 100,000 NC residents). Adults 20 years of age and older had a rate 1.5 times higher than persons less than 20 years of age (0.28 versus 0.19 per 100,000, respectively). Most cases (82%, N=23) were in adults 20 years and older.

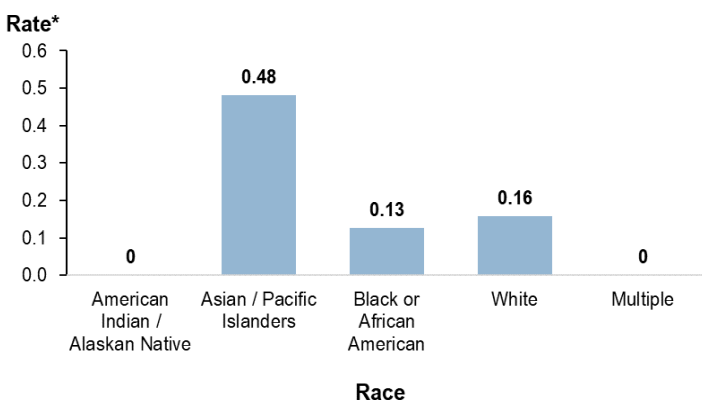
**Dengue rate was highest among persons aged 20 to 49 years old.**

NC 2023 dengue rates by age group



**Dengue rate was highest among Asian or Pacific Islanders.**

NC 2023 dengue rates by race

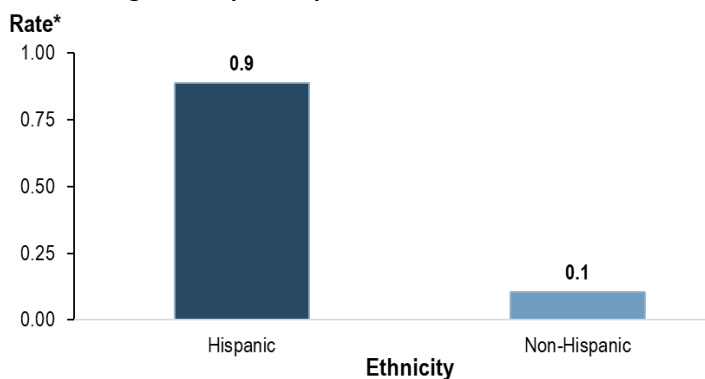


Forty-three percent (43%, N=12) of 2023 dengue cases were white. However, Asian or Pacific Islanders had an infection rate 3.0 times higher than White North Carolina residents (0.48 versus 0.16, respectively).

In 2023, Hispanic North Carolinians were infected with dengue 8.5 times more than non-Hispanic North Carolinians (0.88 versus 0.10 per 100,000 NC residents).

**Dengue rate was highest among Hispanic North Carolinians.**

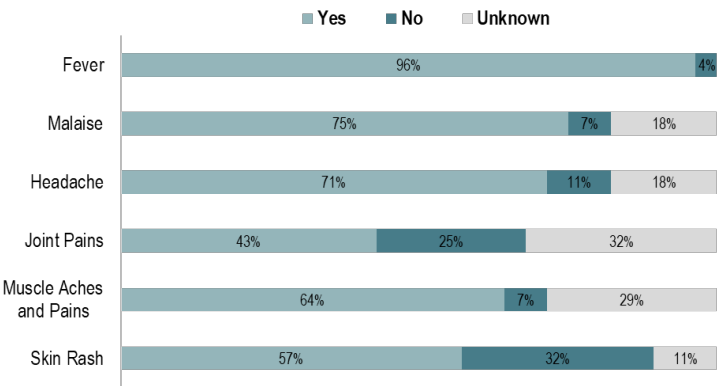
NC 2023 dengue rates by ethnicity



The most common symptom experienced was fever (96%), followed by malaise (75%), headache (71%), and muscle aches and pains (64%).

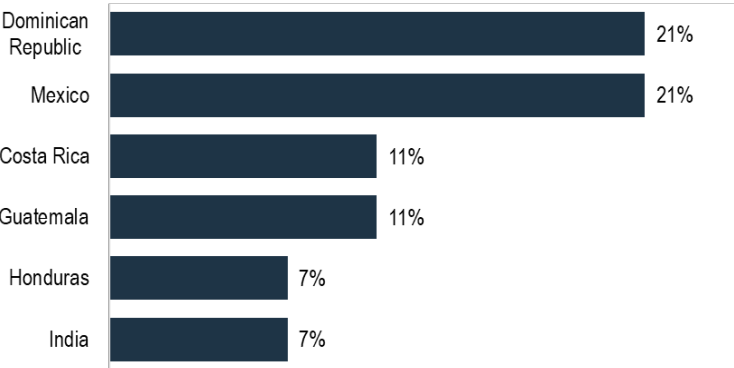
### Almost all dengue cases were febrile during their illness.

NC 2023 dengue cases clinical manifestation



### All dengue cases reported international travel.

NC 2023 dengue cases top five countries of travel\*



\*Honduras and India tied for fifth. Some individuals reported travel to multiple countries.

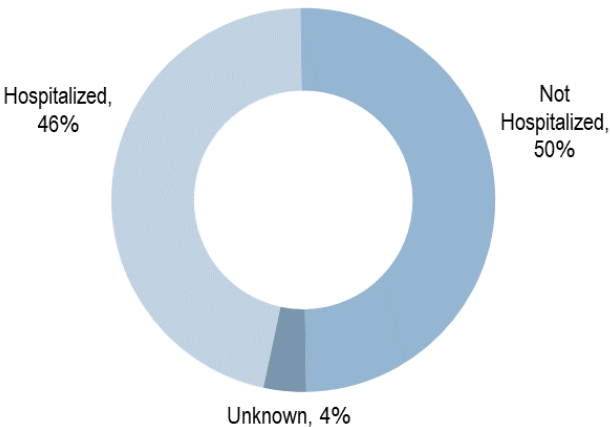
In 2023, all (100%) cases of dengue in North Carolinians occurred in individuals who had reported travel to areas with known dengue transmission, outside of the continental United States. Travel to the Dominican Republic (21% of cases) and Mexico (21% of cases) were the most frequent.

From 2018 to 2023, NC dengue cases most frequently reported travel to India (22%), Mexico (22%), Dominican Republic (20%) and Costa Rica (15%).

Thirteen (46%) cases were hospitalized for their illness in 2023, and all (100%) cases recovered. The hospitalization rate in 2023 was almost two times higher than the 5-year average (0.12 versus 0.06 per 100,000 NC residents).

### Dengue cases needed hospitalized about half the time.

NC 2023 dengue cases by clinical severity



NC Dengue Statistics	Count	Percent (%)	Rate*	Previous 5-year Average** Count	Previous 5-year Average** Percent (%)	Previous 5-year Average** Rate*
Total Cases	28	100	0.26	11	100	0.11
<b>Sex</b>						
Male	14	50	0.26	5	47	0.09
Female	14	50	0.25	7	53	0.12
<b>Race</b>						
White	12	43	0.16	4	33	0.06
Black / African American	3	11	0.13	1	4	0.03
Asian / Pacific Islander	2	7	0.48	3	24	0.73
American Indian / Alaskan Native	0	0	0.0	0	0	0.0
Multiple	0	0	0.0	0	0	0.0
Other	7	25	--	1	10	--
Unknown	4	14	--	2	28	--
<b>Ethnicity</b>						
Hispanic	11	39	0.89	3	24	0.28
Non-Hispanic	10	36	0.10	6	51	0.06
Unknown	7	25	--	2	25	--
<b>Age Group</b>						
0-4 years	0	0	0.0	0	0	0.0
5-9 years	1	4	0.16	<1	2	**
10-19 years	4	14	0.29	1	16	0.10
20-49 years	17	61	0.40	6	51	0.15
50-74 years	5	18	0.16	3	30	0.11
75+ years	1	4	0.13	0	0	0.0
<b>Additional Details</b>						
Travel – associated <sup>1</sup>	28	100	0.26	11 <sup>^</sup>	100	0.11
Hospitalizations	13	46	0.12	21	38	0.06
Deaths	0	0	0.0	0	0	0.0

\*Rate per 100,000 North Carolina residents; rates supported by counts <5 should be interpreted with caution

\*\* Previous 5-year average refers to years 2018 to 2022. Counts and percents are rounded to the nearest whole number; average counts less than one corresponding rate suppressed

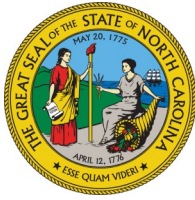
<sup>1</sup> Travel – associated cases are instances when NC residents travel to areas outside of NC, where dengue virus is known to occur, and become infected

<sup>2</sup> Average 5-year travel associated cases includes one lab-associated case and two cases with possible local transmission

Note: Cases are counted using earliest date of illness identification against the Council for State and Territorial (CSTE) dengue case definition. Data are entered and downloaded from the North Carolina Electronic Disease Surveillance System (NCEDSS). These data reflect reported cases and may be missing asymptomatic cases.



NC DEPARTMENT OF  
**HEALTH AND  
HUMAN SERVICES**  
Division of Public Health



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Division of Public Health

Developed by the North Carolina Division of Public Health, Communicable Disease Branch

### ***Ehrlichiosis Surveillance from 2018—2023***

#### **Background**

Ehrlichiosis is a general name to describe several bacterial infections caused by *Ehrlichia spp.* including *E. chaffeensis*, *E. ewingii*, or *E. muris eauclairensis*. Ehrlichiae are transmitted to humans through the bite of an infected tick. In North Carolina, the most common vector of ehrlichiosis is the lone star tick, *Amblyomma americanum*. Like other tickborne illnesses, Ehrlichiosis can be prevented; it is a serious illness that can be fatal if not promptly treated.

#### **Symptomology**

Symptoms of ehrlichiosis typically appear within 1—2 weeks following a tick bite. While there are a number of symptoms, the combination of symptoms can vary from person to person. Symptoms may include fever, headache, fatigue, chills, malaise, muscle aches, nausea, vomiting, diarrhea, confusion, conjunctivitis (red eyes), and a rash. Rashes can be present in up to 60% of children and less than 30% of adults.

#### **Epidemiology**

##### National

Incidence varies considerably by geographic area. Ehrlichiosis is most frequently reported in the southeastern and south-central US. From 2017—2021, five states accounted for nearly half of all reported cases of ehrlichiosis: Missouri, Arkansas, North Carolina, New York, and Tennessee.<sup>1</sup> The number of reported ehrlichiosis cases has increased since it was added to the National Notifiable Conditions list in 1998; the case fatality rate continues to hover around 1% annually. The national average incidence of ehrlichiosis of confirmed and probable cases in 2020 was 0.36 cases per 100,000.<sup>2</sup>

##### North Carolina

The number of reported confirmed and probable cases of ehrlichiosis has fluctuated between 2018 and 2023. The highest incidence of ehrlichiosis typically occurs during the months of June to August. The 5-year average incidence rate of ehrlichiosis in North Carolina between 2018—2022 was 1.11 confirmed and probable cases per 100,000 residents, which is higher than the national average. The incidence rate of ehrlichiosis in North Carolina in 2023 was 1.42 cases per 100,000 (based on 2023 population data), nearly four times the national average.

#### **Diagnosis**

Diagnosis of ehrlichiosis is often difficult because symptoms vary from patient to patient and are non-specific, making it difficult to distinguish from other illnesses. Serological and Polymerase Chain Reaction (PCR) tests can be used to confirm clinical diagnosis. However, serological tests are often negative during the acute phase of illness; healthcare providers should use their judgement to treat patients empirically based on the symptoms above.

#### **Prevention**

Reducing exposure to ticks is the best defense against ehrlichiosis. There are a number of methods that can be used to prevent tickborne illness:

- Wear permethrin treated clothing (0.5%) when exploring the outdoors.
- Use Environmental Protection Agency (EPA) registered insect repellents containing DEET or picaridin to deter ticks.
- Avoid contact with ticks by avoiding wooded and brushy areas with high grasses and leaf litter and walking in the center of trails.
- Check clothing and skin for ticks you may have encountered while outdoors; shower soon after returning indoors.

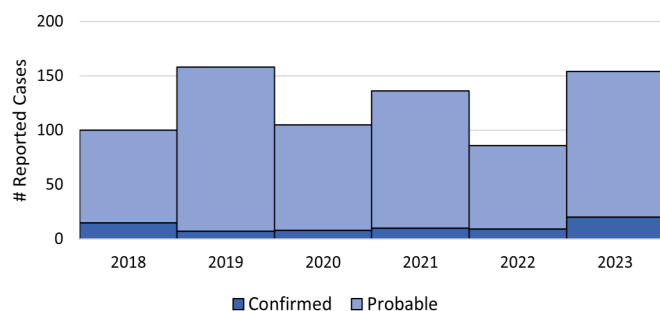
## Case Demographics (Confirmed & Probable)

Sex	5 Year Avg (2018-22)		2023	
	No. of Cases	% of total	No. of Cases	% of total
Male	61	52.5%	89	57.8%
Female	56	47.5%	65	42.2%

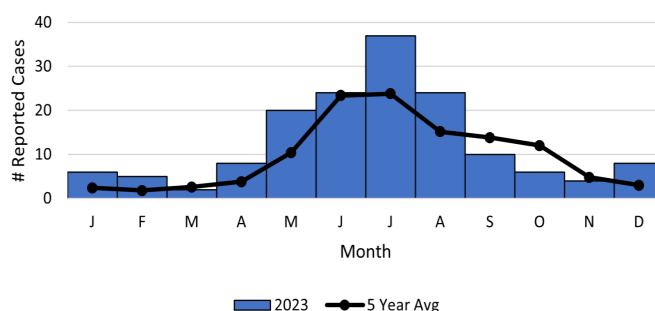
Race	5 Year Avg (2018-22)		2023	
	No. of Cases	% of total	No. of Cases	% of total
White	84	71.8%	118	76.6%
Black or African Amer.	12.2	10.4%	15	9.7%
Asian or Pac. Islander	2.4	2.1%	0	0.0%
Amer. Indian or Alaskan	<1	<1%	0	0.0%
Other	<1	<1%	8	5.2%
Unknown	13.4	11.5%	7	4.5%

Hispanic Ethnicity	5 Year Avg (2018-22)		2023	
	No. of Cases	% of total	No. of Cases	% of total
Yes	5	3.9%	8	5.2%
No	91	77.8%	130	84.4%
Unknown	21	18.3%	16	10.4%

Confirmed and Probable Cases of Ehrlichiosis by Year, NC, 2018-2023; n= 739



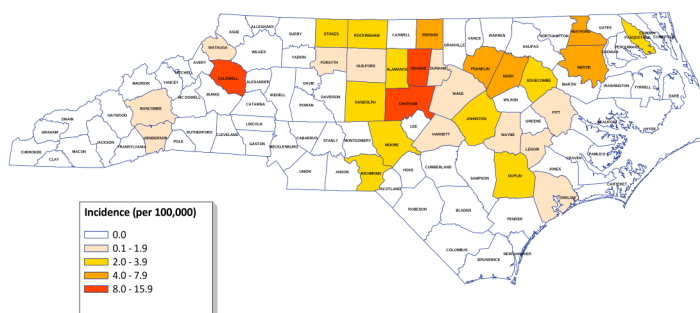
Confirmed and Probable Ehrlichiosis Cases by Month of Illness Onset, NC



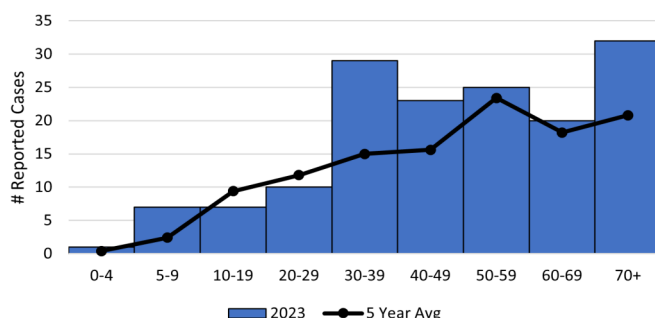
Geographic Distribution

Cases by Age

Confirmed and Probable Incidence of Ehrlichiosis Cases by County of Residence, NC, 2023

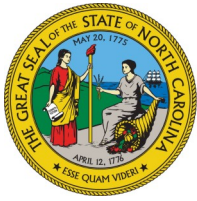


Confirmed and Probable Ehrlichiosis Cases by Age Range, NC



<sup>1</sup>Data are based on a national surveillance data found at: <https://www.cdc.gov/ehrlichiosis/stats/index.html>

<sup>2</sup>Data are based on a national surveillance data found at: <https://wonder.cdc.gov/nndss/static/2020/annual/2020-table2f.html>



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### ***Lyme Disease Surveillance Summary from 2018—2023***

#### **Background**

Lyme disease is a bacterial infection caused by *Borrelia burgdorferi*, and is transmitted to humans and animals through the bite of infected *Ixodes scapularis* (blacklegged) ticks. Symptoms of Lyme disease include fever, headache, fatigue, and a characteristic bull's-eye rash called erythema migrans (EM). If left untreated, infection can spread to the joints, heart, and nervous system. Diagnosis is based on the presence of symptoms, clinical findings (like an EM rash), exposure to ticks, and serological testing. Most cases of Lyme disease are effectively treated with antibiotics.

#### **Symptomology**

Early signs of Lyme disease include fever, chills, headache, fatigue, muscle and joint aches, swollen lymph nodes, and EM rash. It is important to note that an EM rash only occurs in 70—80% of patients, and can take up to 30 days to appear. Untreated Lyme disease can cause a variety of symptoms including severe headaches and neck stiffness, additional EM rashes, arthritis with severe joint pain and swelling, particularly in the knees and other large joints, facial palsy and heart conditions associated with Lyme carditis.

#### **Epidemiology**

##### National

Reported cases of Lyme disease are centered in the Northeast and upper Midwest of the United States. The top ten states of reported cases by year include: Connecticut, Maine, Maryland, Massachusetts, Minnesota, New Jersey, New York, Pennsylvania, Virginia, and Wisconsin.<sup>1</sup> The reported national incidence rate in 2020 was 5.43 **confirmed and probable** cases per 100,000 residents.<sup>2</sup>

##### North Carolina

In North Carolina, the reported number of confirmed and probable cases of Lyme disease has remained stable over the past five years. The highest incidence of Lyme disease in 2023 is largely clustered in the northwestern portion of the state, particularly in Ashe, Alleghany, Madison, Mitchell, Watauga, and Yancey counties. The 5-year reported average incidence rate of Lyme disease in North Carolina between 2018—2022 was 2.82 **confirmed and probable** cases per 100,000 residents, which is significantly lower than the national average. The estimated incidence of Lyme disease in 2023 was 2.39 **confirmed and probable** cases per 100,000 residents. In 2022 and 2023, there were a significant increases in confirmed Lyme disease cases in North Carolina. While the cause is unclear, this may be attributed to increased awareness among physicians leading to increased testing via Modified Two-Tiered Testing (MTTT). In 2022, the national case definition for Lyme disease was amended, which may have had an impact on increased Lyme disease reporting.

#### **Diagnosis**

Lyme disease can be diagnosed by a physician with the use of serological testing. Serological tests are effective when used correctly. For the purposes of surveillance and diagnosis, FDA approved Standard Two Tier Test (STTT) or Modified Two Tier Test (MTTT) are appropriate. An initial (first tier) positive or equivocal enzyme immunoassay (EIA) or immunofluorescent assay (IFA) followed by a second positive IgM or IgG EIA (MTTT) or a positive Immunoglobulin M1 (IgM) or Immunoglobulin G2 (IgG) western immunoblot (STTT) can help to determine active infection. Lab tests are not recommended for patients who do not have symptoms of typical Lyme disease.

#### **Prevention**

Reducing exposure to ticks is the best defense against Lyme disease. There are a number of methods that can be used to prevent tickborne illness:

- Wear permethrin treated clothing (0.5%) when exploring the outdoors.
- Use EPA registered insect repellents containing DEET or picaridin to deter ticks.
- Avoid ticks in wooded/brushy areas with high grasses and leaf litter by walking in the center of trails.
- Check clothing and skin for ticks you may have encountered while outdoors; shower soon after returning indoors.



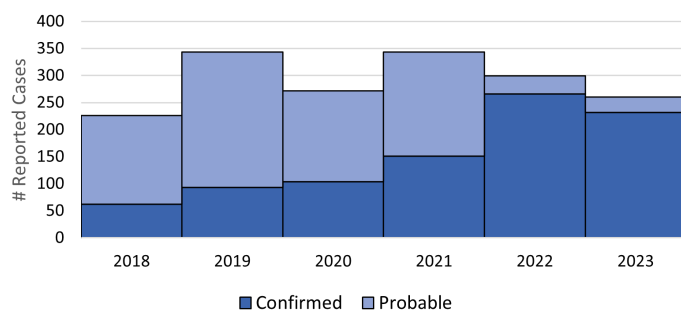
## Case Demographics (Confirmed & Probable)

Sex	5 Year Avg (2018-22)		2023	
	No. of Cases	% of total	No. of Cases	% of total
Male	162	54.7%	158	60.8%
Female	134	45.2%	102	39.2%

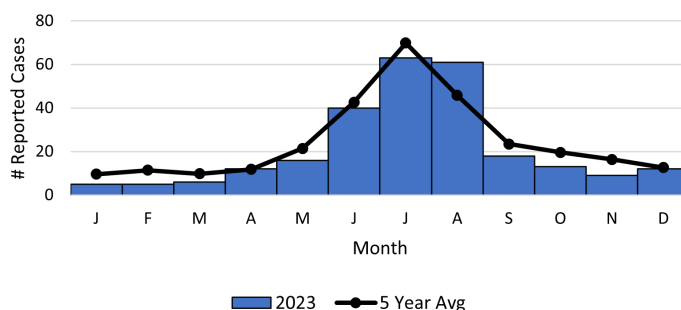
Race	5 Year Avg (2018-22)		2023	
	No. of Cases	% of total	No. of Cases	% of total
White	160	54.0%	193	74.2%
Black or African Amer.	7	2.5%	4	1.5%
Asian or Pac. Islander	1	0.5%	2	0.8%
Amer. Indian or Alaskan	0	0.0%	1	0.4%
Other	3	0.9%	8	3.1%
Unknown	125	42.1%	52	20.0%

Hispanic Ethnicity	5 Year Avg (2018-22)		2023	
	No. of Cases	% of total	No. of Cases	% of total
Yes	5	1.8%	8	3.1%
No	131	44.0%	100	38.5%
Unknown	161	54.2%	152	58.5%

Confirmed and Probable Cases of Lyme Disease by Year, NC, 2018-2023; n= 1743

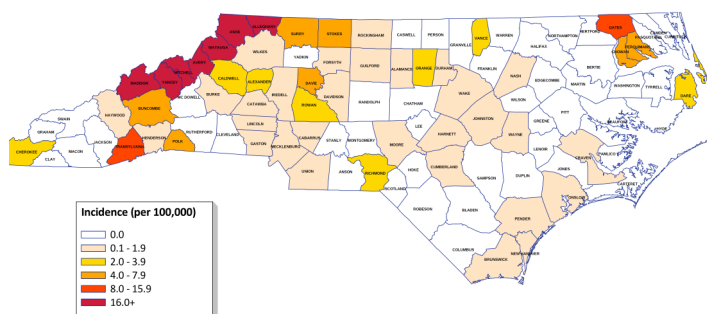


Confirmed and Probable Lyme Disease Cases by Month of Illness Onset, NC



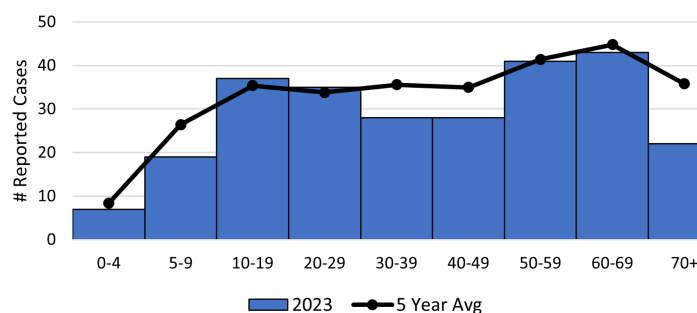
## Geographic Distribution

Confirmed and Probable Incidence of Lyme Disease Cases by County of Residence, NC, 2023



## Cases by Age

Confirmed and Probable Lyme Disease Cases by Age Range, NC



<sup>1</sup>These data are based on a national surveillance data found at: <https://www.cdc.gov/lyme/datasurveillance/surveillance-data.html>

<sup>2</sup>CDC Lyme Disease Data Tables: <https://wonder.cdc.gov/nndss/static/2020/annual/2020-table2j.html>

<sup>3</sup>Modified Two-Tiered Testing: <https://www.aphl.org/aboutAPHL/publications/Documents/ID-2021-Lyme-Disease-Serologic-Testing-Reporting.pdf>



## Malaria Surveillance in North Carolina, 2023

Malaria is a severe disease caused by a *Plasmodium* parasite. The parasite is transmitted by infected *Anopheles* mosquitoes to humans. Mosquitoes can become infectious after biting an infected human and spread the disease to others. Malaria does not spread from person to person. However, transfusion transmission and transmission through organ transplantation have been documented.

Malaria infections can range from a mild, flu-like illness with fever, headache, chills, muscle aches, and gastrointestinal symptoms to life-threatening symptoms such as kidney failure, seizures, confusion, and coma.

Nationally, malaria risk is low as it is not endemic in the United States. However, there has been locally transmitted disease<sup>1</sup> in recent years, stemming from individuals with recent international travel where malaria is circulating.

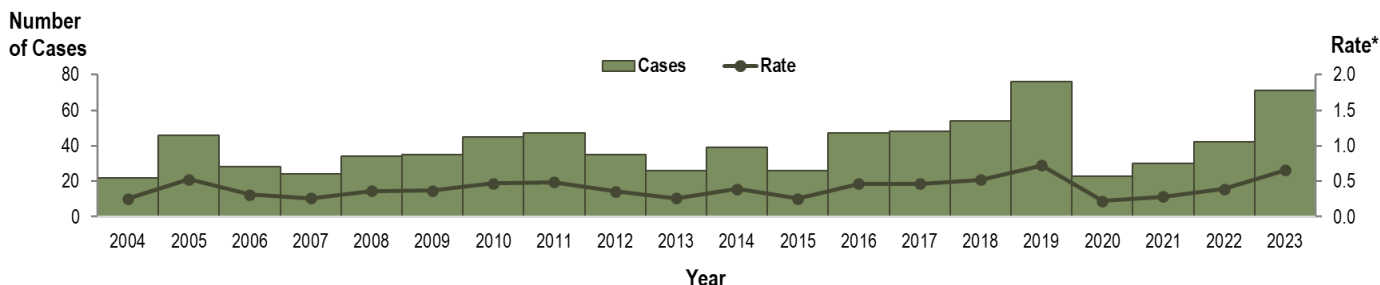
When traveling internationally to countries with endemic malaria transmission, malaria [prophylaxis](#) is recommended. Take other precautions to avoid mosquitoes and [mosquito bites](#).

### Malaria Epidemiology

Malaria cases in North Carolina (NC) have remained low over the past 20-years, averaging 40 cases annually. Malaria cases and rates have been steadily increasing over the last four years.

**North Carolina malaria cases and rates spiked in 2023, following a yearly increase since 2020.**

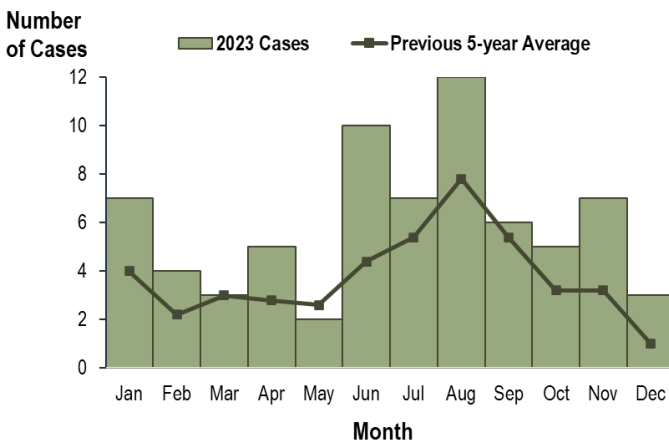
NC 2004-2023 malaria case count and rate by year



There were 71 cases of malaria among North Carolinians in 2023, a rate of 0.66 per 100,000 NC residents. This is 7.6 times higher than the five-year average rate (2018 to 2022; 0.66 versus 0.09 per 100,000 North Carolinians, respectively). Forty-one percent (41%) of 2023 cases occurred during the summer months (June – August).

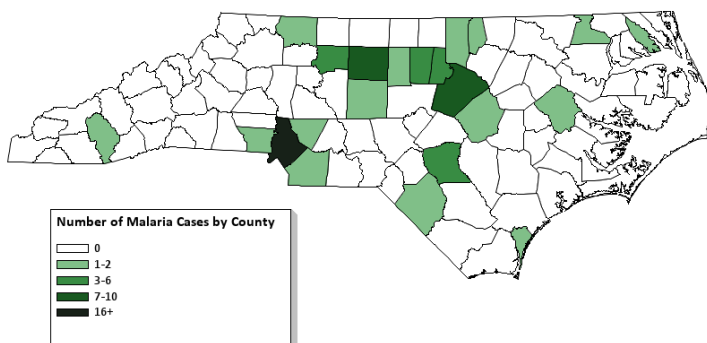
**Malaria cases spiked during the summer in 2023.**

NC 2023 malaria cases by month with previous 5-year average\*\* comparison



**Mecklenburg County had the most malaria cases in 2023.**

NC 2023 malaria cases by county



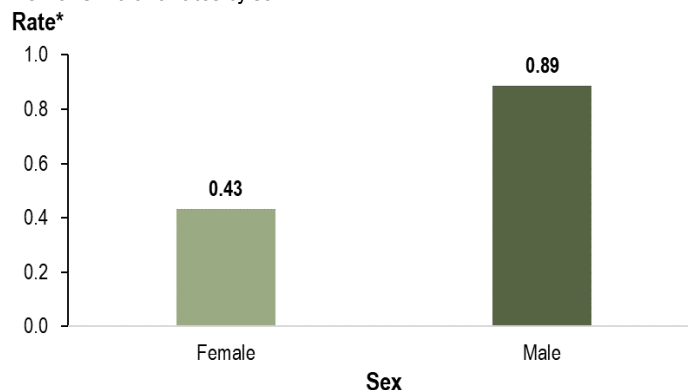
Cases occurred in 22 counties (22% of 100 counties) across NC in 2023. Notably, 20 cases (28%) were residents of Mecklenburg County.

## Malaria Case Demographics

In 2023, males had an infection rate 2.1 times higher than females (0.89 versus 0.43 per 100,000 North Carolinians, respectively).

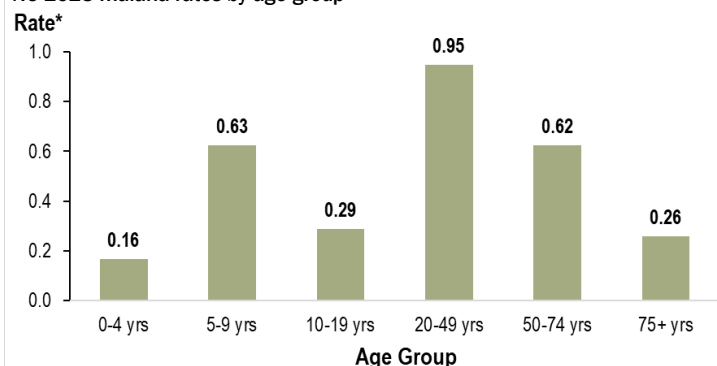
**Males were more likely to be infected with malaria than females.**

NC 2023 malaria rates by sex



**Most malaria cases were among adults.**

NC 2023 malaria rates by age group

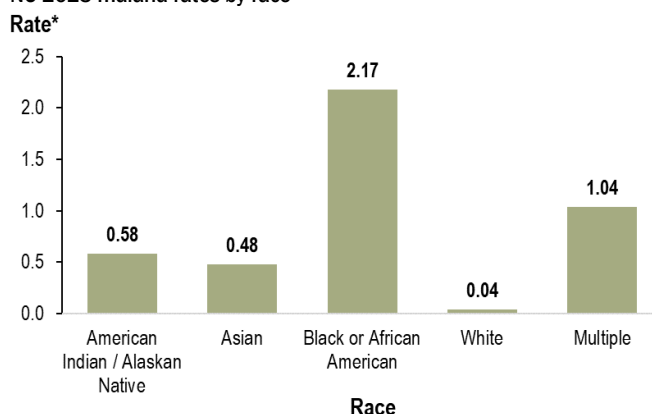


Most 2023 malaria cases were adults ages 20 to 74 years (85%). North Carolina adults 20 years of age or older had a malaria infection rate 2.2 times higher than those ages less than 20 years old (0.76 versus 0.34 per 100,000 North Carolinians, respectively).

Seventy-three percent (73%; N = 52) of 2023 malaria cases were among Black or African American North Carolinians. Infection rate among Black or African American NC residents was 54.8 times higher than white NC residents (2.17 versus 0.04 per 100,000, respectively).

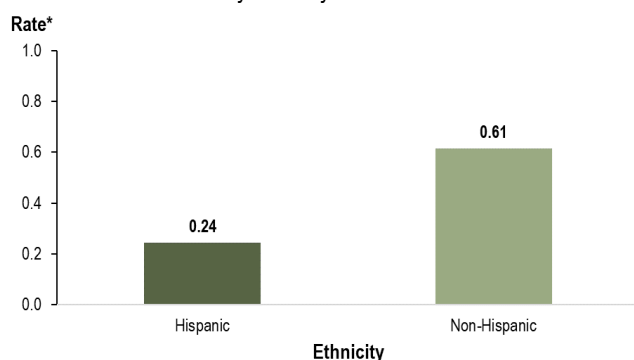
**Black or African American North Carolinians had the highest rate.**

NC 2023 malaria rates by race



**Malaria rates were 2.6x higher in non-Hispanic North Carolinians.**

NC 2023 malaria rates by ethnicity

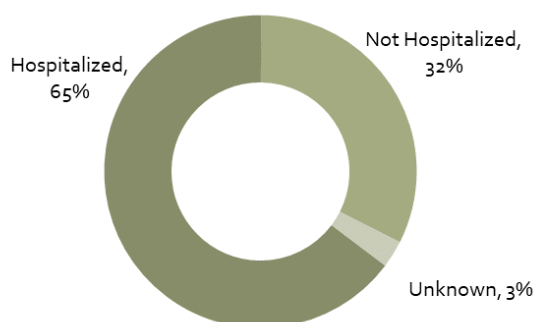


In 2023, non-Hispanic NC residents were 2.6 times more likely to be infected with malaria than Hispanic North Carolinians (0.62 versus 0.24 per 100,000 NC residents).

Fever was the only consistent symptom among NC malaria cases in 2023 (96% of cases affected). Additionally, 32% of cases experienced anemia. Forty-one percent (41%; N=29) of cases experienced complications related to the malaria infection, many of which sought hospitalization.

### Many malaria cases needed to be hospitalized (N=46).

NC 2023 malaria cases by clinical severity

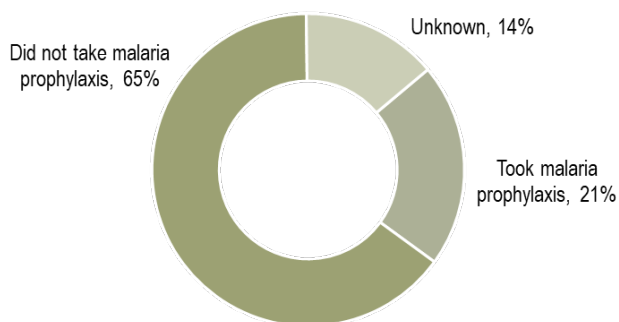


All (100%) of 2023 NC malaria cases reported international travel during their exposure period. Travel to Nigeria (17% of cases), Cote d'Ivoire (11%), and Ghana (8%) were the most frequent.

From 2018 to 2023, NC malaria cases most frequently reported travel to Nigeria (18%), Ghana (7%), Liberia (7%), Sierra Leone (7%) and Afghanistan (6%).

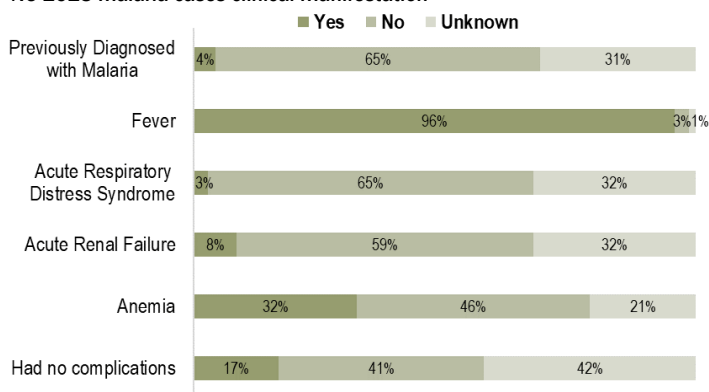
### Most cases did not take malaria prophylaxis before travel.

NC 2023 malaria cases by whether prophylaxis was taken before travel



### Almost all malaria cases were febrile.

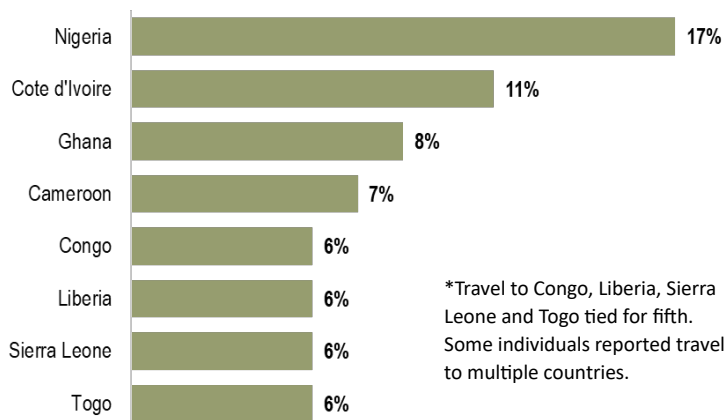
NC 2023 malaria cases clinical manifestation



Sixty-five percent (65%; N=46) of NC 2023 malaria cases were hospitalized during their infection. The hospitalization rate for 2023 was 1.8 times higher than the 5-year average (0.42 versus 0.23 per 100,000 NC residents).

### Malaria cases most often reported travel to Nigeria.

NC 2023 malaria cases top five countries of travel\*



\*Travel to Congo, Liberia, Sierra Leone and Togo tied for fifth. Some individuals reported travel to multiple countries.

Despite all 2023 malaria cases having a travel history, only 21% (N=15) reported taking malaria prophylaxis prior to travel.

NC Malaria Statistics	Count	Percent (%)	Rate*	Previous 5-year Average** Count	Previous 5-year Average** Percent (%)	Previous 5-year Average** Rate*
Total Cases	71	100	0.66	45	100	0.43
<b>Sex</b>						
Male	47	66	0.89	30	67	0.59
Female	24	34	0.43	15	33	0.27
<b>Race</b>						
White	3	4	0.04	6	14	0.08
Black / African American	52	73	2.17	30	64	1.27
Asian / Pacific Islander	2	3	0.48	<1	<1	**
American Indian / Alaskan Native	1	1	0.58	0	0	0.0
Multiple	3	4	1.04	1	1	0.23
Other	7	10	--	3	6	--
Unknown	3	4	--	6	14	--
<b>Ethnicity</b>						
Hispanic	3	4	0.24	1	2	0.08
Non-Hispanic	59	83	0.62	31	65	0.33
Unknown	9	13	--	13	32	--
<b>Age Group</b>						
0-4 years	1	1	0.13	2	4	0.33
5-9 years	4	6	0.63	2	3	0.26
10-19 years	4	6	0.29	5	9	0.35
20-49 years	40	56	0.95	25	61	0.61
50-74 years	20	28	0.62	11	22	0.35
75+ years	2	3	0.26	<1	<1	0.06
<b>Additional Detail</b>						
Malaria prophylaxis	15	23	0.14	8	17	0.01
Travel – associated <sup>1</sup>	39	55	0.36	45 <sup>2</sup>	100	0.43
Hospitalizations	46	65	0.42	24	54	0.23
Deaths	0	0	0.0	<1	<1	**

\*Rate per 100,000 North Carolina residents; rates supported by counts <5 should be interpreted with caution

\*\* Previous 5-year average refers to years 2018 to 2022. Counts and percents are rounded to the nearest whole number; average counts less than one corresponding rate suppressed

<sup>1</sup> Travel – associated cases are instances when NC residents travel to areas outside of NC, where malaria is known to occur, and become infected

<sup>2</sup> One case included in the 5-year average only had domestic travel and was determined to have been infected at an airport.

Note: Cases are counted using earliest date of illness identification against the Council for State and Territorial (CSTE) malaria case definition. Data are entered and downloaded from the North Carolina Electronic Disease Surveillance System (NCEDSS). These data reflect reported cases and may be missing asymptomatic cases.



NC DEPARTMENT OF  
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Division of Public Health



## NC DEPARTMENT OF HEALTH AND HUMAN SERVICES

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MARK BENTON • Deputy Secretary for Health

SUSAN KANSAGRA MD, MBA • Assistant Secretary for Public Health

Division of Public Health

Developed by the North Carolina Division of Public Health, Communicable Disease Branch

### ***Spotted Fever Rickettsiosis Surveillance Summary from 2018—2023***

#### **Background**

Spotted fever rickettsioses (SFR), including Rocky Mountain spotted fever (RMSF), are a group of bacterial infections caused by *Rickettsia* spp. including *R. rickettsii* and *R. parkeri*, among others. Spotted fevers are transmitted to humans through the bite of an infected tick. In North Carolina the most common vectors of spotted fevers include the American dog tick, *Dermacentor variabilis*, and the Lone star tick, *Amblyomma americanum*. The brown dog tick, *Rhipicephalus sanguineus* and the Rocky Mountain wood tick, *D. andersoni*, has been implicated in transmission in other parts of the US. If left untreated, illness can become serious, even leading to death.

#### **Symptomology**

Early signs of SFR are non-specific, including fever and headache. Symptoms may appear 3–12 days following a tick bite. Other signs and symptoms can include nausea, vomiting, stomach pain, muscle pain, lack of appetite, and rash (may be present or absent). Rash is a common sign among those infected with *R. rickettsii*, the causative agent of RMSF, and usually develops 2–4 days following fever onset. Rashes can look like red splotches or pinpoint dots.

#### **Epidemiology**

##### National

Incidence varies considerably by geographic area. Between 2017–2021, more than 50% of reported SFR cases originated from five states: Alabama, Arkansas, Missouri, North Carolina, and Tennessee<sup>1</sup>. Thousands of cases of SFR occur every year, but it is unknown how many cases are RMSF. Case fatality rates vary annually, but have decreased overall from 28% in 1944 to < 1% in 2024<sup>1</sup>. The national average incidence of **confirmed and probable** SFGR cases in 2020 was 0.35 cases per 100,000.<sup>2</sup>

##### North Carolina

The number of confirmed and probable cases of spotted fever rickettsiosis decreased significantly in North Carolina since 2020. In January 2020, the case definition of SFR was amended to require an elevated IgG antibody titer of  $\geq 1:128$  within 60 days of illness onset<sup>3</sup>, which resulted in a sharp decrease in SFGR cases nationwide. Additionally, case counts of all vector-borne diseases experienced a decrease between 2020–2021, likely due to the COVID-19 pandemic. The SFGR cases increased slightly in 2023 compared to 2022 numbers. The 5-year average incidence rate of SFGR in North Carolina between 2018—2022 was 3.35 **confirmed and probable** cases per 100,000 residents, which is higher than the national average<sup>2</sup>. The incidence of **confirmed and probable** SFGR cases in North Carolina in 2023 was 2.62 cases per 100,000 residents.

#### **Diagnosis**

Delay in diagnosis and treatment is the most important factor associated with poor outcomes, and early treatment based on clinical impression is the best way to prevent RMSF progression. Both acute and convalescent serum specimens are needed to confirm the rickettsial infection. Serological tests are often negative during the acute phase of illness, however, physicians may diagnose patients based on the symptoms outlined above.

#### **Prevention**

Reducing exposure to ticks is the best defense against SFGR. There are a number of methods that can be used to prevent tickborne illness:

- Wear permethrin treated clothing (0.5%) when exploring the outdoors.
- Use EPA registered insect repellents containing DEET or picaridin to deter ticks.
- Avoid ticks in wooded/brushy areas with high grasses and leaf litter by walking in the center of trails.
- Check clothing and skin for ticks you may have encountered while outdoors; shower soon after returning indoors.

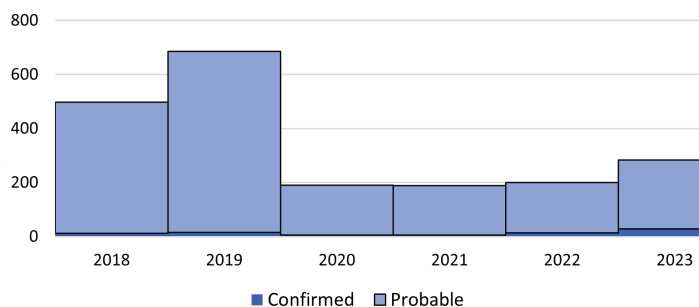
## Case Demographics (Confirmed and Probable)

Sex	5 Year Avg (2018-22)		2023	
	No. of Cases	% of total	No. of Cases	% of total
Male	236	67.1%	202	71%
Female	116	32.9%	82	29%

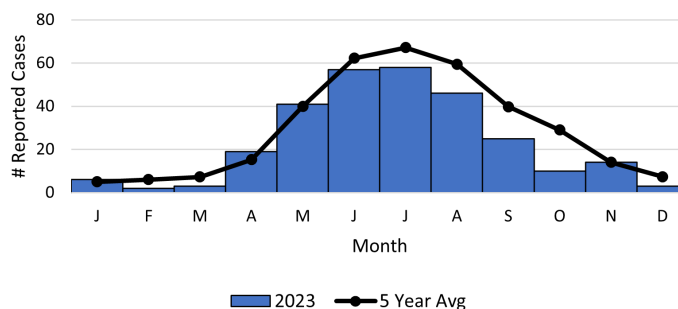
Race	5 Year Avg (2018-22)		2023	
	No. of Cases	% of total	No. of Cases	% of total
White	214	60.6%	198	69.7%
Black or African Amer.	20	5.6%	34	12%
Amer. Indian or Alaskan	1	0.3%	3	1.1%
Asian	3	1.0%	3	1.1%
Other	10	2.8%	19	6.7%
Unknown	164.8	46.8%	27	9.5%

Hispanic Ethnicity	5 Year Avg (2018-22)		2023	
	No. of Cases	% of total	No. of Cases	% of total
Yes	13	3.7%	17	6.0%
No	196	55.7%	174	61.3%
Unknown	143	40.6%	93	32.7%

Confirmed and Probable Spotted Fever Rickettsiosis by Year, NC, 2018-2023; n= 2046

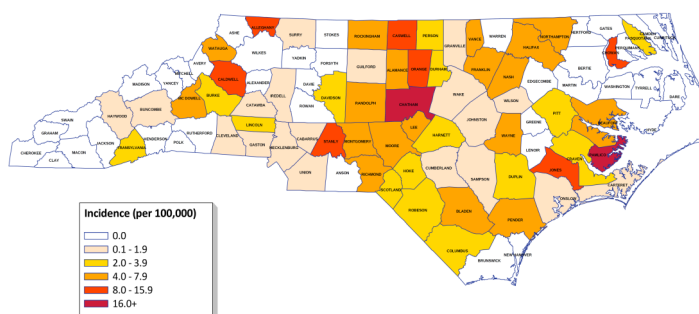


Confirmed and Probable Spotted Fever Rickettsiosis cases by Month of Illness Onset, NC



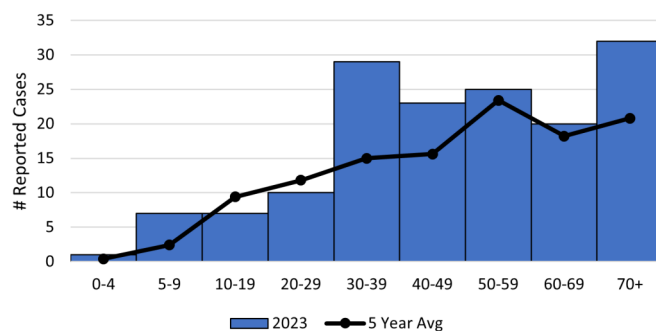
## Geographic Distribution

Confirmed and Probable Incidence of Spotted Fever Group Rickettsiosis Cases by County of Residence, NC, 2023



## Cases by Age

Confirmed and Probable Ehrlichiosis Cases by Age Range, NC



<sup>1</sup> Rocky Mountain Spotted Fever Facts: <https://www.cdc.gov/rmsf/stats/index.html>

<sup>2</sup> Data are based on a national surveillance data found at: <https://wonder.cdc.gov/nndss/static/2019/annual/2019-table2p-H.pdf>

<sup>3</sup> CDC Spotted Fever Group Rickettsiosis Case Definition: <https://ndc.services.cdc.gov/case-definitions/spotted-fever-rickettsiosis-2020/>



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## **West Nile Encephalitis Surveillance, North Carolina, 2012—2023**

### **Background**

West Nile virus (WNV) is transmitted to humans and horses by the bite of infected mosquitoes. It is in the genus *Flavivirus*, family *Flaviviridae*.

### **Transmission**

Over 150 species of mosquitoes have been known to carry WNV, but the main vector species in the U.S. are *Culex pipiens*, *Culex tarsalis*, and *Culex quinquefasciatus*. These mosquitoes are most active at night, and most cases of infection occur during the summer and early fall months. In a very small number of cases, WNV also has been spread through blood transfusions, organ transplants, breastfeeding and during pregnancy from mother to baby. It is not spread person-to-person or from animal-to-person by casual contact.

### **Symptoms**

Most people infected with WNV will have no symptoms. About 20% of people who are infected will have symptoms such as fever, headache, body aches, vomiting, diarrhea, and rash. Approximately 1% of people will develop serious disease that can include high fever, convulsions, paralysis and sometimes lasting neurological effects. Severe WNV neuroinvasive disease may include encephalitis (inflammation of the brain) or meningitis (inflammation of the membranes that surround the brain and spinal cord). Ten percent of severe WNV cases are fatal. Severe disease occurs most often in people over 60 years of age. In North Carolina, currently only neuroinvasive human cases are reportable.

### **Epidemiology**

WNV is the most common arboviral disease in the United States, and second most common (after La Crosse encephalitis virus) in North Carolina. Since its introduction to the U.S. in 1999, WNV has spread throughout the continental U.S. with most cases occurring in the upper Midwestern states and the northern Plains states. In North Carolina, neuroinvasive WNV was first documented in 2002. Since then, there has been a total of 106 confirmed and probable neuroinvasive WNV cases in North Carolina, distributed across the state with no geographic predilection. Cases of WNV have been reported in 45% of North Carolina Counties since 2003. Note that equine WNV cases are reportable to the NC Dept. of Agriculture, and are useful as an indicator of active WNV transmission between mosquitoes and mammals, therefore prompting local vector control programs to initiate adult mosquito suppression if appropriate. There were 153 reported equine cases of WNV between 2003 and 2023.

### **Diagnosis and Treatment**

Diagnosis of neuroinvasive WNV is based on signs and symptoms in combination with the presence of IgM antibodies in serum or cerebrospinal fluid (CSF), virus, or viral antigens. Antibodies begin to be detectable 3 to 8 days after onset of illness. Testing on days 0 through 3 may result in a false negative test. The presence of antibodies in blood or CSF provides good evidence of WNV infection, however cross-reactivity with other flaviviruses is possible. No specific anti-viral treatments for WNV are available. Therefore, in severe cases necessitating hospitalization the only available treatment is supportive care.

### **Prevention**

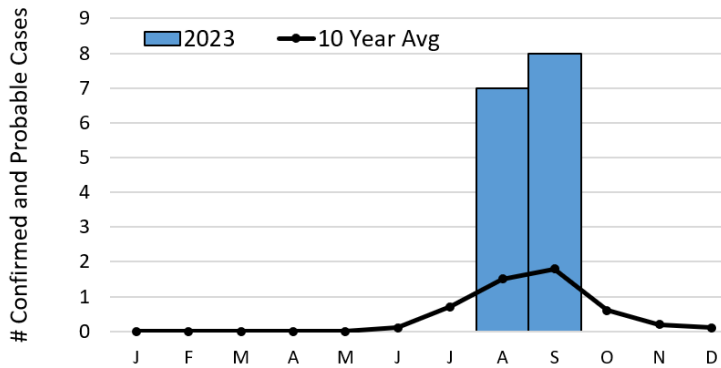
There are no vaccines available for WNV in humans, however a vaccine is available for horses. The best method to prevent WNV infection is to avoid mosquito bites, such as:

- Using repellents containing DEET, picaridin, IR3535, or oil of lemon eucalyptus
- Eliminating mosquito breeding sites by emptying standing water from flower pots, buckets, barrels, tires and other containers at least weekly, or by drilling holes so water drains out
- Wearing long sleeves, pants and socks when weather permits
- Having secure intact screens on windows and doors to keep mosquitoes out
- Reducing the number of infected adult mosquitoes through actions by local mosquito control programs



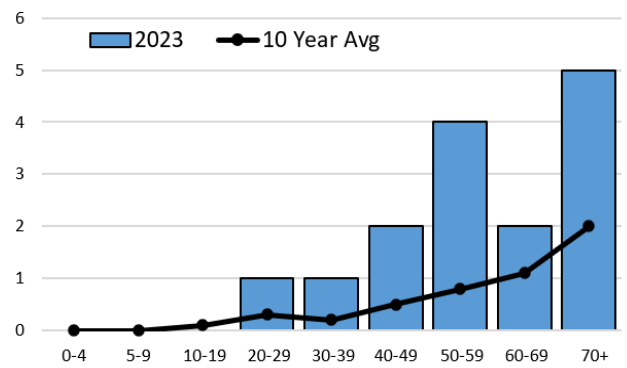
## Cases by Month

Confirmed and Probable Human West Nile Neuroinvasive Cases by Month of Illness Onset, NC, 2013-2023



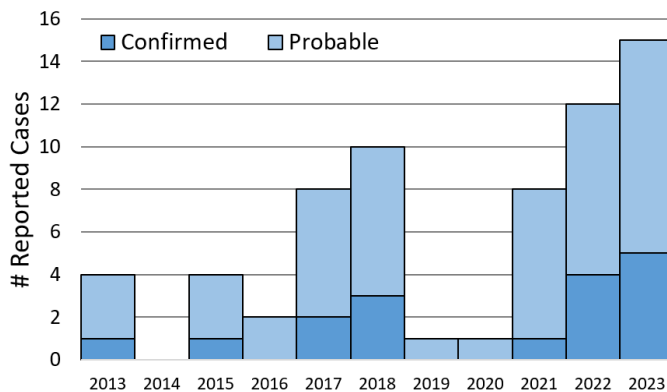
## Case Demographics

Confirmed and Probable Human West Nile Neuroinvasive Cases by Age, NC, 2013-2023

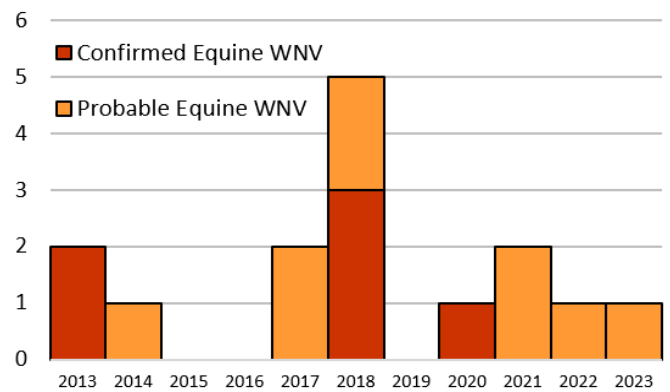


## Cases by Year

Confirmed and Probable Human West Nile Neuroinvasive Cases by Year, NC, 2013-2023

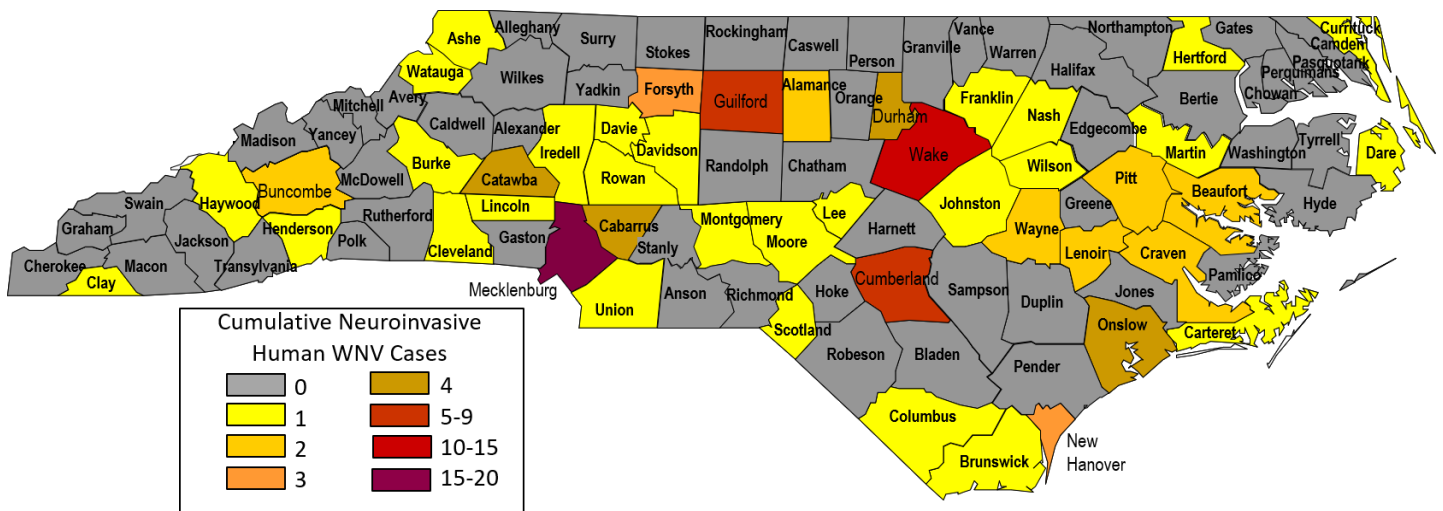


Confirmed and Probable Equine Cases of West Nile Neuroinvasive Disease by Year, NC, 2013-2023



## Geographic Distribution

West Nile Virus Reported Human Neuroinvasive Cases by County of Residence, NC, 2003-23



View near-real-time national surveillance data at: <https://www.cdc.gov/westnile/statsmaps/current-season-data.html>