



Vaccine-Preventable Diseases Reported in North Carolina, 2022

Controlling vaccine-preventable diseases (VPDs) requires consistent, concerted and coordinated efforts of public health agencies and healthcare providers to rapidly identify and report suspected cases and swiftly implement control measures. Although many VPDs remain at or near record low levels, maintaining high immunization rates is still critical to prevent reemergence. This annual surveillance report summarizes 14 VPDs, nine of which were reported in North Carolina during 2022. Additional details regarding case and disease statistics and surveillance data for which cases were reported are presented on subsequent pages.

Surveillance Highlights: Mpox (formerly known as monkeypox) emerged as a global outbreak in 2022, primarily affecting gay, bisexual, and other men who have sex with men (MSM). Over 700 cases of mpox were reported in North Carolina during 2022. Cases of invasive meningococcal disease increased significantly during 2022, although no specific outbreaks or high risk groups were identified. Varicella cases also increased significantly, likely due to reporting becoming more commonplace after varicella became a reportable condition in 2020. Case numbers for pertussis continue to be much lower than the five-year average. No cases of diphtheria, measles, polio, rubella, or congenital rubella syndrome were reported.

Report Specifications. Notable information about this report includes:

- Cases include those classified as confirmed or probable and are only among North Carolina residents.
- Cases are counted using the earliest date of illness identification which is most frequently the onset date. Therefore, case counts in this report may differ slightly from those included in national summaries which can be based on other dates such as date of initial report or the date when cases were closed and reported to the Centers for Disease Control and Prevention (CDC).
- Ages are based on the date when the case was entered in the North Carolina Electronic Disease Surveillance System (NC EDSS).
- Incidence rates are based on data obtained from the U.S. census population estimates project. Note that estimates of rates based on a small number of cases are unstable and can fluctuate widely. Therefore, these estimates should be interpreted with caution. Ninety-five percent confidence intervals are shown for demographic-specific rates.
- Fourteen VPDs are shown in the table below. Data for other VPDs in North Carolina such as [influenza](#) and [hepatitis B](#) are summarized in separate reports. Diseases with one case in the table below will not have an individual data page, to protect the individual's identity.
- Please note that case classification criteria are subject to change each year and counts may fluctuate based on these changes.

Number of Cases of VPDs Reported in North Carolina, 2017-2022								
Disease	2017	2018	2019	2020	2021	Previous five-year average	2022	Significant Change*
Diphtheria	0	0	0	0	0	0	0	--
<i>Haemophilus influenzae</i> , invasive disease	206	209	242	129	110	179	218	--
Hepatitis A	30	100	162	521	945	352	106	--
Measles	0	3	0	0	0	1	0	--
Meningococcal invasive disease	9	8	9	7	9	8	18	↑
Mpox (formerly monkeypox)	0	0	0	0	0	0	703	↑
Mumps	37	12	89	21	2	32	2	--
Pertussis (whooping cough)	431	386	496	191	52	311	46	--
Pneumococcal meningitis	52	44	54	23	25	40	62	--
Polio	0	0	0	0	0	0	0	--
Rubella	0	0	0	0	0	0	0	--
Congenital rubella syndrome	0	0	0	0	0	0	0	--
Tetanus	3	3	0	0	0	1	1	--
Varicella (chickenpox)	n/a	n/a	n/a	13	32	23	98	↑

* ↑ = significant increase (≥ 2 standard deviations above average) ↓ = significant decrease (≥ 2 standard deviations below average) -- = no significant change

***Haemophilus influenzae*, invasive disease**

Background

Haemophilus influenzae can cause a variety of clinical syndromes, including invasive diseases like bacteremia, pneumonia, meningitis, and epiglottitis. *H. influenzae* organisms are divided into serotypes a, b, c, d, e, and f, based on proteins found in the capsule that surrounds the organism. Strains without a capsule are called non-typeable. All serotypes, including non-typeable serotypes, can cause invasive disease and are reportable in North Carolina. *Haemophilus influenzae* serotype b (Hib) is the most virulent and is the only serotype for which there is a vaccine.

H. influenzae is often part of the normal respiratory flora. Carriage of Hib has dramatically decreased due to vaccination, but non-typeable strains can be found in the nose and throat of up to 80% of the population. It is transmitted from person to person by respiratory droplets. *H. influenzae* is not carried by animals and does not persist for long in the environment.

Hib was the leading cause of bacterial meningitis in children under five years of age before vaccine was available. Approximately 4% - 5% of Hib meningitis cases were fatal, and 20% of children who survived had complications such as hearing loss or developmental delays. Hib meningitis and other invasive Hib infections are now rare in the United States since the introduction of Hib vaccine into the routine childhood immunization series.

Immunization

The first conjugate Hib vaccine was licensed in 1987 and is recommended by the Centers for Disease Control and Prevention's (CDC) Advisory Committee on Immunization Practices (ACIP). Infants are recommended to receive three or four doses (depending on the type of vaccine) by 15 months of age. There are no vaccines for non-b or nontypeable *H. influenzae*. In North Carolina, Hib vaccination is required for all children under the age of five.

According to the 2022 National Immunization Survey (NIS), it is estimated that 76.7% of North Carolinian children born in 2020 had completed the full *H. influenzae* vaccine series by 24 months of age. Nationally, it is estimated that 78.2% of 24-month-old children had completed the full series.

Epidemiology

National

The rate of Hib disease has decreased by greater than 99% in children since 1987, while rates in adults have remained the same. Rates of Hib among Alaska Native populations remain higher than the rest of the United States. The success of the vaccine has caused a shift in the epidemiology of *H. influenzae*. The majority of invasive *H. influenzae* infections are now caused by nontypeable strains and primarily affect children under five years of age and adults over 65 years of age.

North Carolina

The number of invasive *H. influenzae* cases in North Carolina increased in 2022, after seeing a decrease in cases the previous two years. In 2022, 218 cases were reported, which is double the number of cases that were reported in 2021 and in line with the trend during pre-pandemic years when over 200 reported cases were typical. It is possible that the COVID-19 pandemic affected *H. influenzae* surveillance and testing procedures, although the exact cause of the large decrease in cases during both 2020 and 2021 is unknown.

None of the cases of invasive *H. influenzae* reported in 2022 were type b. The large majority of cases in North Carolina were caused by nontypeable strains (69%). The age group most affected in North Carolina reflects the national trend; adults aged 50 years and older made up 73% of cases.

Outbreaks

No outbreaks of invasive *H. influenzae* were reported in North Carolina during 2022.

Haemophilus influenzae , invasive disease, 2022

Annual Summary

	2018	2019	2020	2021	2022
Cases	209	242	129	110	218
Rate*	2.1	2.4	1.3	1.1	2.0

Case Statistics, 2022

Sex	Cases	%	Rate*	95% CI
Male	100	46%	1.9	1.6, 2.3
Female	118	54%	2.2	1.8, 2.6
Unknown	0	0%	--	--

Age Group

Age Group	Cases	%	Rate*	95% CI
Infant	12	6%	9.9	5.1, 17.2
1-4 yrs	6	3%	1.3	0.5, 2.7
5-9 yrs	3	1%	0.5	0.1, 1.4
10-19 yrs	4	2%	0.3	0.1, 0.8
20-49 yrs	33	15%	0.8	0.5, 1.1
50-74 yrs	85	39%	2.7	2.1, 3.3
75+ yrs	75	34%	9.9	7.8, 12.4
Unknown	0	0%	--	--

Race

Race	Cases	%	Rate*	95% CI
White	139	64%	1.9	1.6, 2.2
Black or African American	47	22%	2.0	1.5, 2.6
American Indian / Alaskan Native	3	1%	1.8	0.4, 5.3
Asian or Pacific Islander	3	1%	0.8	0.2, 2.2
Multiple Races	4	2%	1.4	0.4, 3.7
Other or Unknown	22	10%	--	--

Hispanic Ethnicity

Hispanic Ethnicity	Cases	%	Rate*	95% CI
Yes	9	4%	0.8	0.4, 1.5
No	182	83%	1.9	1.6, 2.2
Unknown	27	12%	--	--

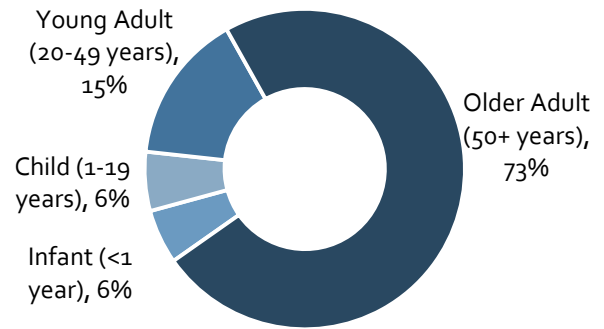
Disease Severity

Disease Severity	Cases	%
Hospitalized	177	81%
Died	24	11%

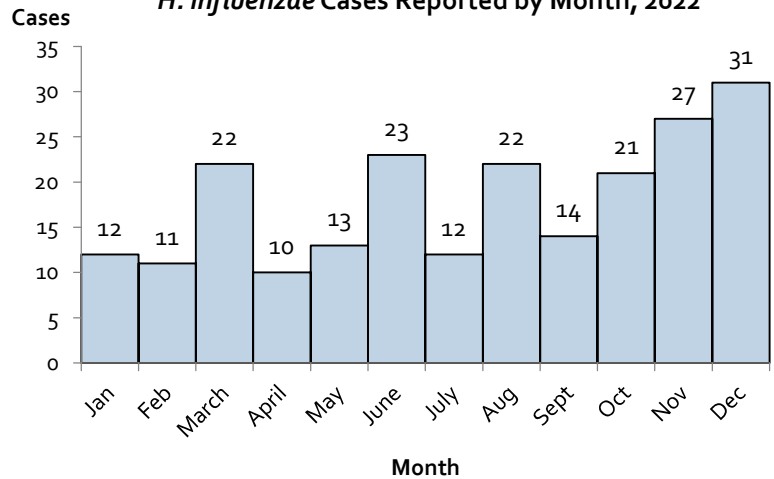
Serotypes

Serotypes	Cases	%
Type b	0	0%
Non-b, typeable	28	13%
Nontypeable	150	69%
Unknown	40	18%

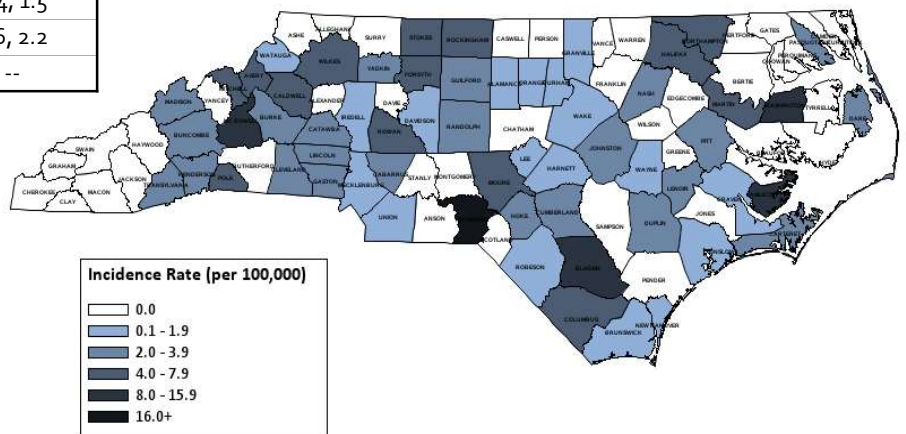
H. influenzae Case Distribution by Age Group , 2022



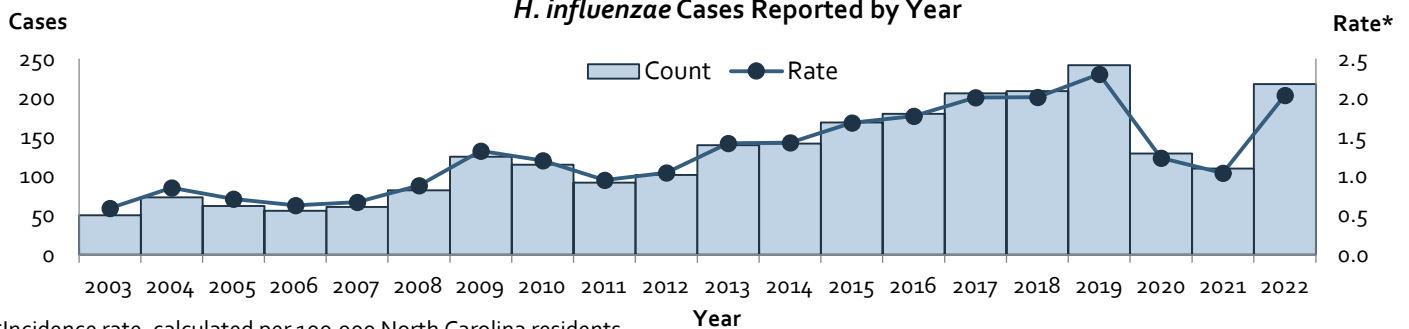
H. influenzae Cases Reported by Month, 2022



H. influenzae Incidence Rates by County, 2022



H. influenzae Cases Reported by Year



*Incidence rate, calculated per 100,000 North Carolina residents

Hepatitis A

Background

Hepatitis A virus (HAV) is a cause of acute liver disease transmitted by the fecal-oral route. In the United States, person-to-person transmission is most common. Common signs and symptoms include nausea, vomiting, abdominal pain, fatigue, and jaundice; however, infection is often asymptomatic in children under six years of age. HAV infection is laboratory confirmed by demonstration of IgM antibody directed against the virus in the patient's serum.

Common-source outbreaks of HAV can occur via fecal contamination of food or water, but a specific source is rarely identified. People at increased risk for acquiring HAV infection include travelers to endemic areas, men who have sex with men, and users of injection drugs, but no risk factor is identified for the majority of cases. Control and prevention of hepatitis A rests upon promotion of personal hygiene, immunization, and proper food and water sanitation.

People with HAV infection are infectious from two weeks before jaundice onset to one week after. If the patient did not have jaundice, or the jaundice onset date is unknown, the infectious period is considered to be from one week before to two weeks after the onset of other symptoms. Shedding can be longer in some cases, particularly in young children.

Post-exposure prophylaxis (PEP) should be considered for susceptible individuals who are household or sexual contacts to a case. Childcare center staff and attendees should receive PEP if one or more cases are identified in the facility, or if cases are identified in two or more households of childcare attendees. If a case is identified in a food handler who worked while infectious, PEP may be considered for other food handlers and patrons. PEP is not generally considered effective if it is given more than two weeks after the exposure.

Immunization

Hepatitis A vaccine has been one of the great success stories of public health. Hepatitis A vaccines were first licensed in 1995, and the number of people for whom vaccine is recommended has gradually expanded since that time. Two doses of hepatitis A vaccine administered at least six months apart are currently recommended as a routine immunization for all children beginning at 12 months of age. Hepatitis A vaccine is also recommended for high-risk populations such as international travelers, men who have sex with men, people who use injection or non-injection drugs, people experiencing homelessness, and people who are or were recently incarcerated. People in these high-risk groups should be offered hepatitis A vaccine even if receipt of the second dose is unlikely; even one dose of hepatitis A vaccine is highly effective at preventing infection. Currently, North Carolina immunization law does not require that individuals be immunized against Hepatitis A.

According to the 2022 NIS results, it is estimated that 85.2% of North Carolinian children born in 2020 had received at least one dose of the Hepatitis A vaccine by 24 months of age, compared to 88.5% nationally. However, a significant decline in coverage was observed for the recommended second dose. An estimated 37.8% of children born in 2020 received at least two doses of Hep A vaccine by 24 months of age, compared to 47.3% nationally. In contrast, 89.2% of adolescents aged 13-17 years had received at least two doses of the Hepatitis A vaccine, compared to 85.0% nationally.

Epidemiology

National

Incidence of hepatitis A remained high in 2021 due to large outbreaks in several states. Infections among certain high-risk populations made up the majority of outbreak-associated cases, including people who use drugs (injection or non-injection) and people experiencing homelessness.

North Carolina

Reported cases of hepatitis A in 2022 decreased greatly when compared to the previous two years, due to the end of the statewide outbreak (discussed below). The 106 reported cases were mostly male (62%) and cases were primarily 20 to 49 years of age (69%). Reported cases in the second half of 2022 returned to baseline levels.

Outbreaks

The statewide outbreak of hepatitis A that began in April 2018 was declared over in 2022. No other outbreaks of hepatitis A were reported in 2022.

Hepatitis A, 2022

Annual Summary

	2018	2019	2020	2021	2022
Cases	100	162	521	945	106
Rate*	1.0	1.6	5.0	8.9	1.0

Case Statistics, 2022

Sex	Cases	%	Rate*	95% CI
Male	66	62%	1.3	1.0, 1.6
Female	40	38%	0.7	0.5, 1.0
Unknown	0	0%	--	--

Age Group

Age Group	Cases	%	Rate*	95% CI
Infant	0	0%	0.0	0.0, 3.0
1-4 yrs	1	1%	0.2	0.0, 1.2
5-9 yrs	0	0%	0.0	0.0, 0.6
10-19 yrs	1	1%	0.1	0.0, 0.4
20-49 yrs	73	69%	1.7	1.4, 2.2
50-74 yrs	26	25%	0.8	0.5, 1.2
75+ yrs	5	5%	0.7	0.2, 1.5
Unknown	0	0%	--	--

Race

Race	Cases	%	Rate*	95% CI
White	57	54%	0.8	0.6, 1.0
Black or African American	6	6%	0.3	0.1, 0.6
American Indian / Alaskan Native	15	14%	9.0	5.1, 14.9
Asian or Pacific Islander	3	3%	0.8	0.2, 2.2
Multiple Races	0	0%	0.0	0.0, 1.3
Other or Unknown	25	24%	--	--

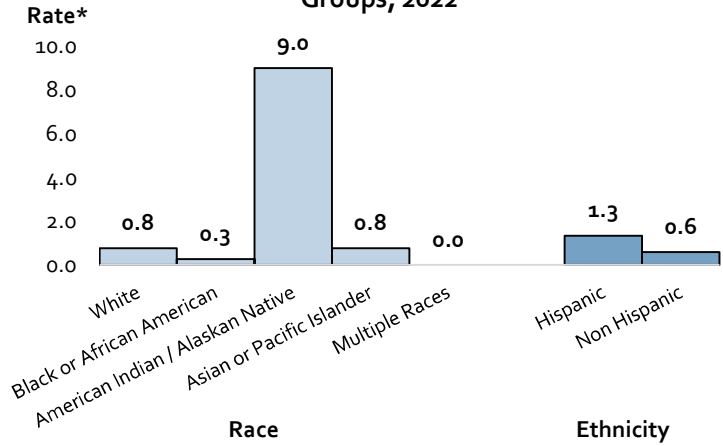
Hispanic Ethnicity

Hispanic Ethnicity	Cases	%	Rate*	95% CI
Yes	15	14%	1.3	0.7, 2.2
No	57	54%	0.6	0.5, 0.8
Unknown	34	32%	--	--

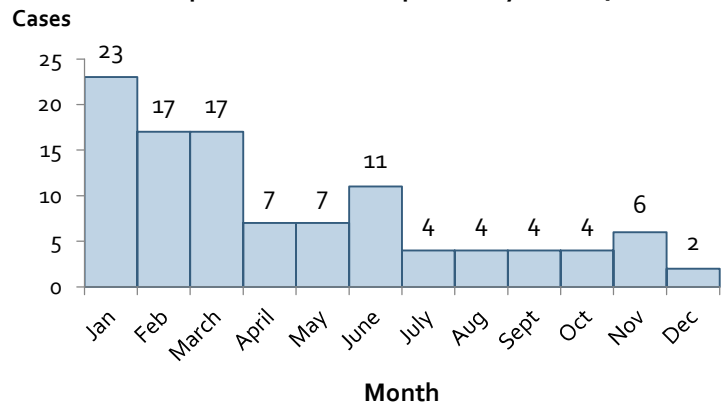
Disease Severity

Hospitalized	56	53%
Died	1	1%

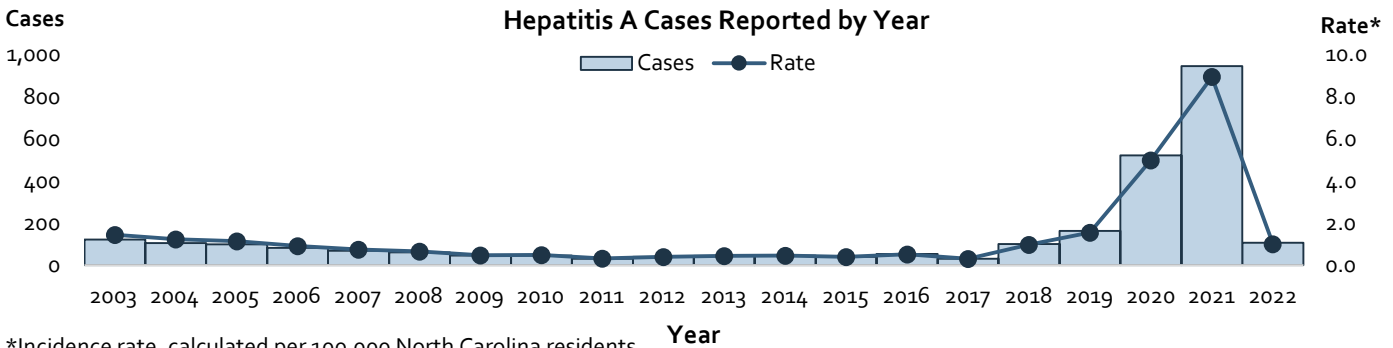
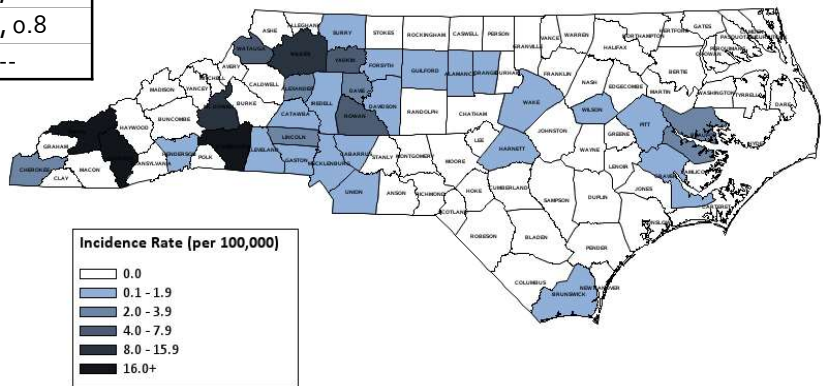
Hepatitis A Rates among Race and Ethnicity Groups, 2022



Hepatitis A Cases Reported by Month, 2022



Hepatitis A Incidence Rate by County, 2022



*Incidence rate, calculated per 100,000 North Carolina residents

Meningococcal Invasive Disease

Background

Invasive meningococcal disease caused by *Neisseria meningitidis* is an acute, serious illness that can cause several syndromes including meningitis, bacteremia, and sepsis. Infections can rapidly progress and result in death. Timely and appropriate antibiotic therapy is important for the treatment of this disease; however, even with the widespread use of antibiotics, the case-fatality rate is estimated to be 10-14%. Six serogroups are responsible for the vast majority of invasive disease: A, B, C, W, X, and Y.

Humans act as a natural reservoir for *N. meningitidis*. Up to 10% of adults are asymptomatic carriers, although most carriers develop immunity against the organism and do not develop invasive disease. Cases of meningococcal disease can occur sporadically or as part of outbreaks. Outbreaks can occur among groups living in close-contact settings, such as college dormitories, or among high-risk populations in a community setting.

Patients are considered infectious beginning 7 days before symptom onset until 24 hours after starting appropriate antibiotics. Post-exposure prophylaxis (PEP) should be given to close contacts within 24 hours after the index patient is identified, if possible. PEP is of limited value if started more than 14 days after the last exposure. Effective antimicrobial regimens for prophylaxis include rifampin, ceftriaxone, and ciprofloxacin. PEP is critically important for close contacts of patients with invasive meningococcal infections, and is recommended for household contacts, childcare contacts, and others with direct exposures to the patient's oral secretions. PEP is not recommended for casual contacts such as coworkers, classmates, or healthcare workers who were not directly exposed to oral secretions.

Immunization

The quadrivalent meningococcal conjugate vaccine was first licensed in 2005. It contains four serogroups (A, C, Y, and W). Two doses are recommended for children by ACIP as part of the routine immunization schedule; the first at 11-12 years, and the second at age 16 years. Vaccination with the quadrivalent and serogroup B vaccine is recommended apart from the routine schedule for various populations considered to be at increased risk for disease, such as immunocompromised children and adults, military recruits, and laboratory workers. In North Carolina, one dose of meningococcal conjugate vaccine is required for 7th grade entry (or by 12 years of age), and a second dose is required for 12th grade entry (or by 17 years of age).

According to the 2022 NIS, it is estimated that 92.8% of North Carolinians aged 13-17 had received at least one dose of the meningococcal conjugate vaccine, which is higher than the estimated 88.6% of teenagers nationally.

Epidemiology

National

The incidence rate of meningococcal disease in the U.S. has been declining since the 1990s, and remains very low at 0.06 per 100,000 people as of 2021. Rates are highest in children less than one year of age, followed by adolescents and young adults. Serogroup B causes the majority of cases in children under five years of age.

North Carolina

Although the incidence rate remains very low, 18 cases of meningococcal invasive disease were identified in 2022, which is double the number of cases in the previous five-year average. No specific cause of this increase has been identified. Serogroup Y caused the largest share of infections (61%). No deaths associated with meningococcal disease were reported in 2022.

Outbreaks

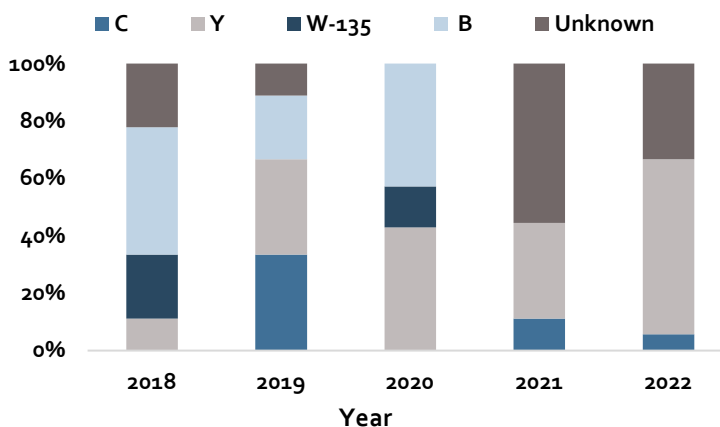
No outbreaks of meningococcal invasive disease occurred in North Carolina during 2022.

Meningococcal Invasive Disease, 2022

Annual Summary

	2018	2019	2020	2021	2022
Cases	9	9	7	9	18
Rate*	0.09	0.09	0.07	0.09	0.17

Proportion of Meningococcal Serogroup Types by Year, 2018-2022



Case Statistics, 2022

Sex	Cases	%	Rate*	95% CI
Male	11	61%	0.2	0.1, 0.4
Female	7	39%	0.1	0.1, 0.3
Unknown	0	0%	--	--

Age Group

Age Group	Cases	%	Rate*	95% CI
Infant	2	11%	1.6	0.2, 5.9
1-4 yrs	0	0%	0.0	0.0, 0.8
5-9 yrs	0	0%	0.0	0.0, 0.6
10-19 yrs	0	0%	0.0	0.0, 0.3
20-49 yrs	7	39%	0.2	0.1, 0.3
50-74 yrs	9	50%	0.3	0.1, 0.5
75+ yrs	0	0%	0.0	0.0, 0.5
Unknown	0	0%	--	--

Race

Race	Cases	%	Rate*	95% CI
White	7	39%	0.1	0.0, 0.2
Black or African American	9	50%	0.4	0.2, 0.7
American Indian / Alaskan Native	0	0%	0.0	0.0, 2.2
Asian or Pacific Islander	0	0%	0.0	0.0, 0.9
Multiple Races	1	6%	0.4	0.0, 2.0
Other or Unknown	1	6%	--	--

Hispanic Ethnicity

Hispanic Ethnicity	Cases	%	Rate*	95% CI
Yes	2	11%	0.2	0.0, 2.6
No	15	83%	0.2	0.1, 0.3
Unknown	1	6%	--	--

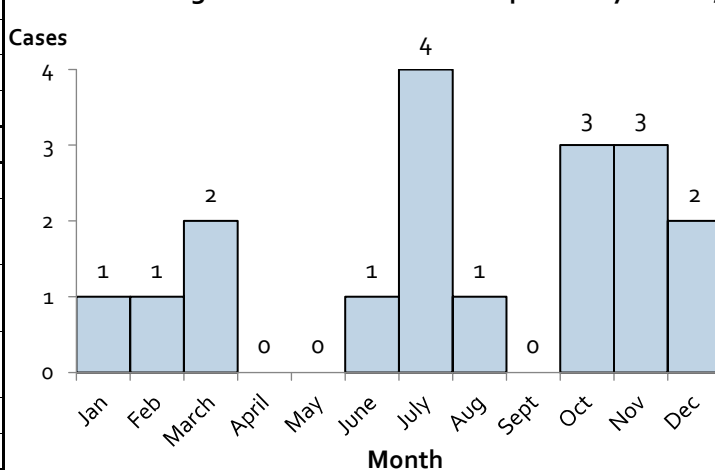
Serogroups

Serogroup	Cases	%
A	0	0%
B	0	0%
C	1	6%
Y	11	61%
W-135	0	0%
Unknown^	6	33%

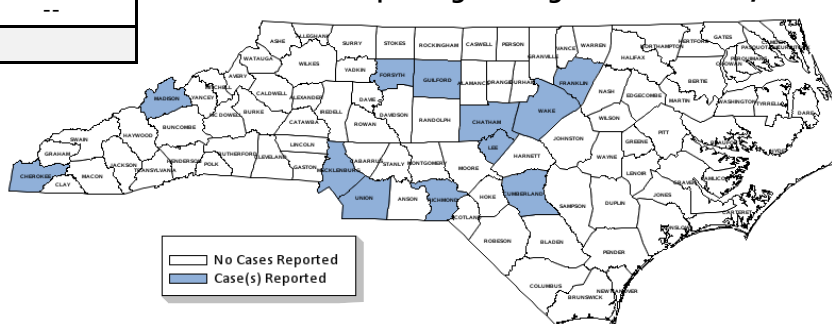
Disease Severity

Severity	Cases	%
Hospitalized	16	89%
Died	0	0%

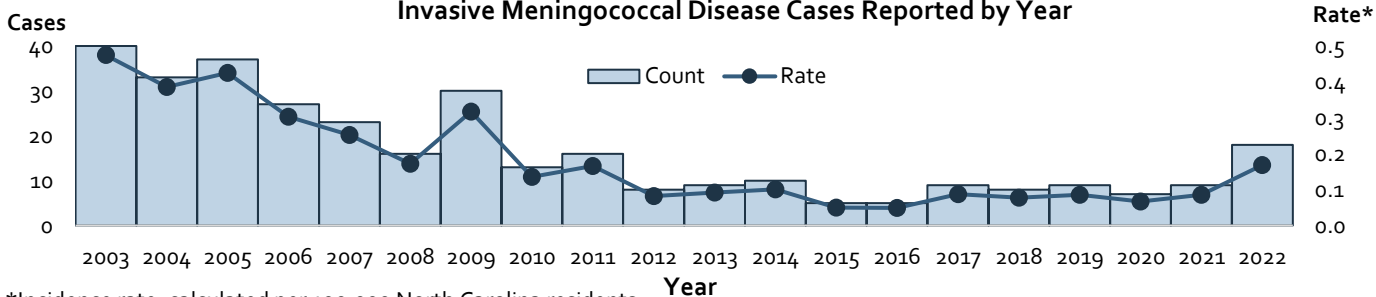
Invasive Meningococcal Disease Cases Reported by Month, 2022



Counties Reporting Meningococcal Disease, 2022



Invasive Meningococcal Disease Cases Reported by Year

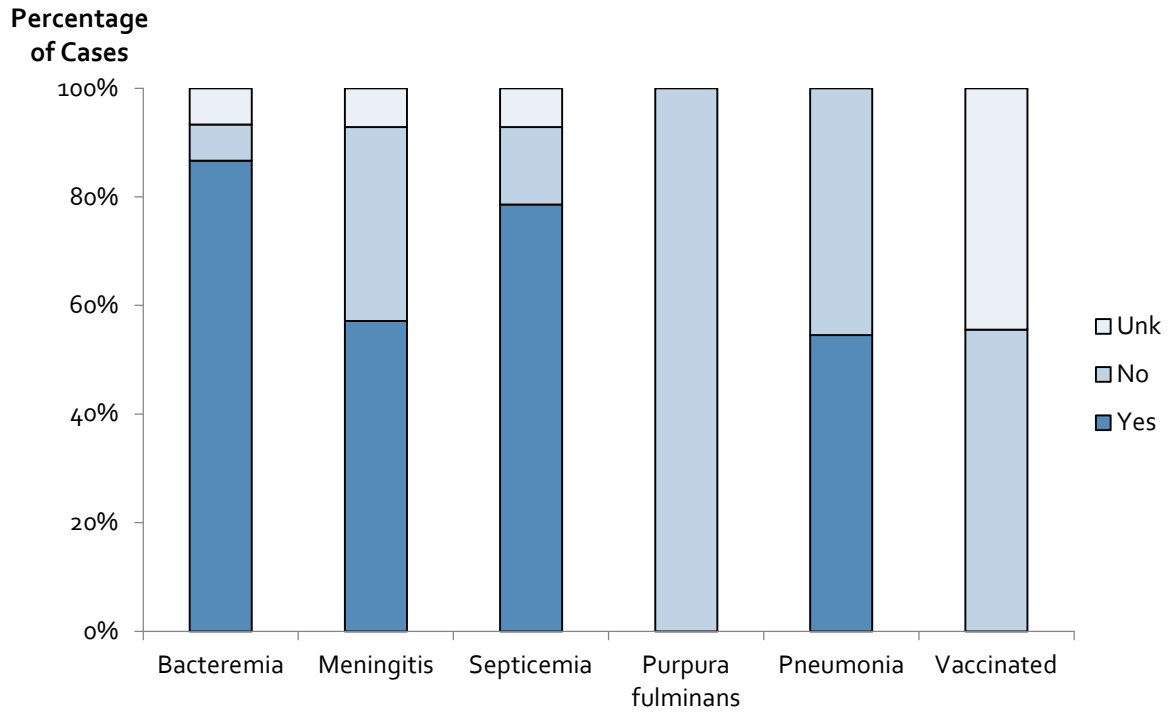


*Incidence rate, calculated per 100,000 North Carolina residents

Meningococcal Invasive Disease, 2022 (continued)

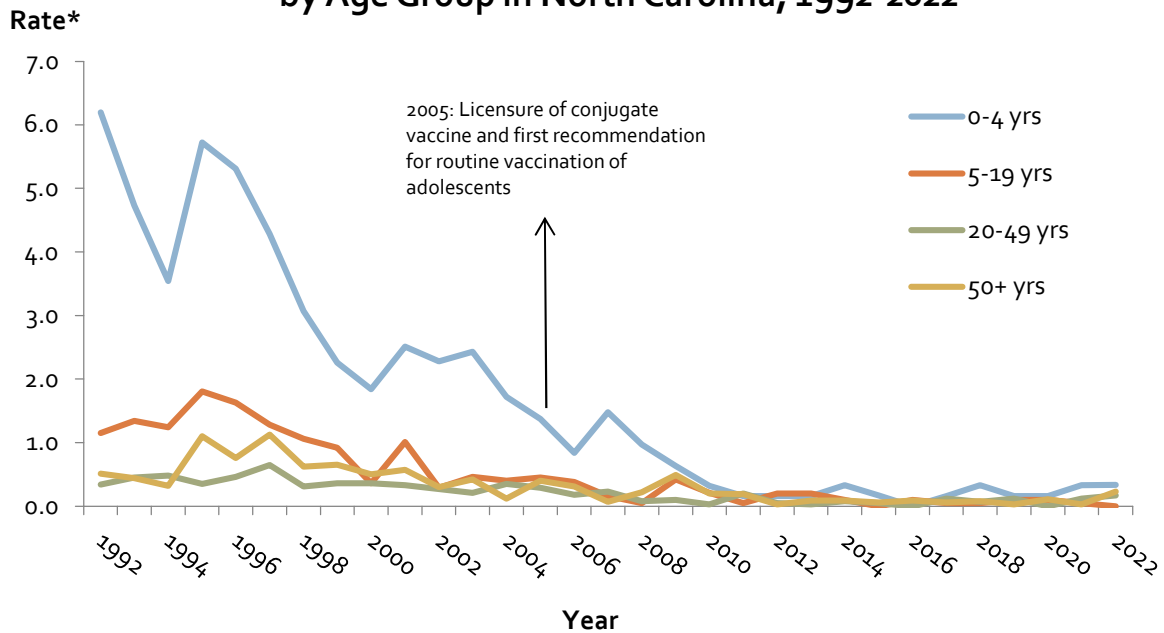
2022 Case Summary

North Carolina 2022 Meningococcal Disease Cases by Clinical Manifestations and by Vaccination Status



Meningococcal Disease Incidence by Age Group

Incidence of Invasive Meningococcal Disease by Age Group in North Carolina, 1992-2022



Mpox

Background

Mpox (formerly known as monkeypox) is a viral disease that can be spread person-to-person through contact with body fluids or lesions, items that have been in contact with fluids or lesions, and respiratory droplets. The incubation period for the disease is generally 7 to 14 days but can range up to 21 days. Infected individuals usually have generalized flu-like symptoms before a rash appears. The rash goes through several stages, finally scabbing over and resolving 2-4 weeks after it first appears. A person infected with mpox is infectious from the start of symptoms until rash lesions heal and new skin growth has caused the scabs to fall off.

Suspicion for mpox should be heightened if the rash occurs in a person who reports having contact with a person or people who have a similar appearing rash or received a diagnosis of confirmed or suspected mpox; had close or intimate in-person contact with person(s) in a social network experiencing mpox infections; or has recently returned from travel to an endemic area.

Certain treatments may be considered for mpox patients who have immunocompromising conditions, lesions in the throat, eyes, or perirectal area, or if the patient is pregnant or a child.

Immunization

Vaccination is the best way to reduce the risk of mpox infection. People who have known or presumed exposure to mpox virus should receive the mpox vaccine as post-exposure prophylaxis. Mpox vaccination should also be offered before exposure to people with high potential for exposure or who anticipate potential exposure.

Two doses of the Jynneos vaccine are recommended for those who meet the vaccine eligibility criteria. The second dose should occur at least 14 days after the initial vaccine to ensure suitable immunity to mpox. Information on vaccine eligibility criteria and uptake can be found on the [NC DHHS mpox webpage](#).

Epidemiology

National

Historically, mpox cases in the U.S. were acquired via zoonotic transmission (from animals) or as a result of travel to endemic areas. This changed in May of 2022, when a global mpox outbreak was identified. The outbreak occurred primarily among gay, bisexual or other men who have sex with men (MSM). As of September 2023, there have been 30,767 total cases and 50 deaths in the United States, with cases being reported from all 50 states, territories, and Washington DC.

North Carolina

North Carolina's first case was identified on June 23, 2022.

Outbreak

The mpox outbreak in North Carolina is ongoing as of September 2023; however, numbers have greatly declined since the end of 2022. There were a total of 703 probable and confirmed cases, along with one death in NC in 2022. The greatest number of cases occurred in August (270 cases). Of North Carolina's 100 counties, 61 had at least one mpox case, with Mecklenburg County having the greatest number of cases (244; 35% of total cases). Most mpox cases in North Carolina were among Black or African American MSM.

Mpox, 2022

Annual Summary

	2018	2019	2020	2021	2022
Cases	0	0	0	0	703
Rate*	0.0	0.0	0.0	0.0	6.6

Case Statistics, 2022

Sex	Cases	%	Rate*	95% CI
Male	674	96%	12.9	11.9, 13.9
Female	29	4%	0.5	0.4, 0.8
Unknown	0	0%	--	--

Age Group

Age Group	Cases	%	Rate*	95% CI
Infant	0	0%	0.0	0.0, 3.0
1-4 yrs	0	0%	0.0	0.0, 0.8
5-9 yrs	0	0%	0.0	0.0, 0.6
10-19 yrs	15	2%	1.1	0.6, 1.8
20-49 yrs	633	90%	15.1	14.0, 16.4
50-74 yrs	55	8%	1.7	1.3, 2.3
75+ yrs	0	0%	0.0	0.0, 0.5
Unknown	0	0%	--	--

Race

Race	Cases	%	Rate*	95% CI
White	173	25%	2.3	2.0, 2.7
Black or African American	476	68%	20.1	18.3, 21.9
American Indian / Alaskan Native	3	0%	1.8	0.4, 5.3
Asian or Pacific Islander	4	1%	1.0	0.3, 2.6
Multiple Races	24	3%	8.6	5.5, 12.8
Other or Unknown	23	3%	--	--

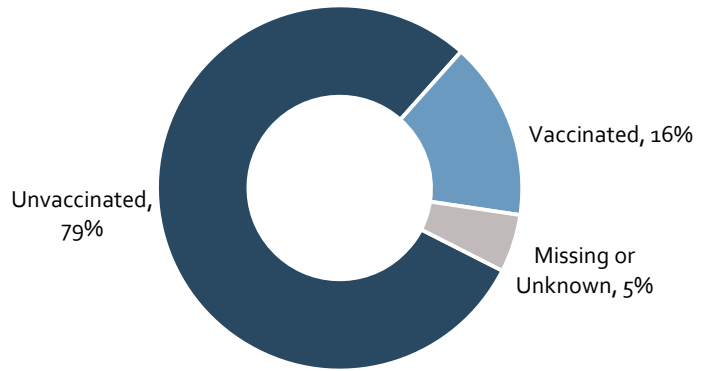
Hispanic Ethnicity

Hispanic Ethnicity	Cases	%	Rate*	95% CI
Yes	84	12%	7.5	6.0, 9.3
No	599	85%	6.3	5.8, 6.8
Unknown	20	3%	--	--

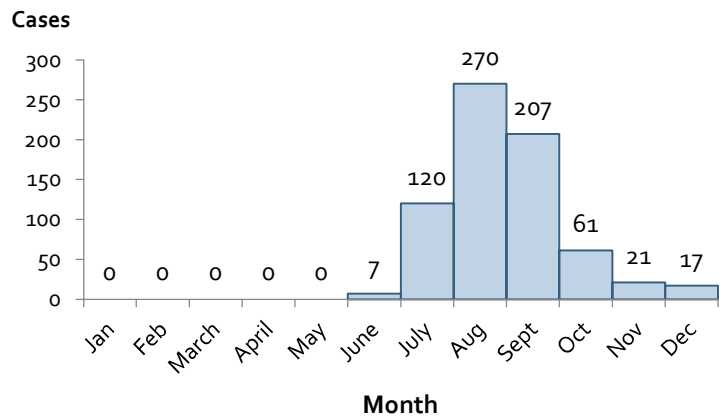
Disease Severity

Hospitalized	43	6%
Died	1	0%

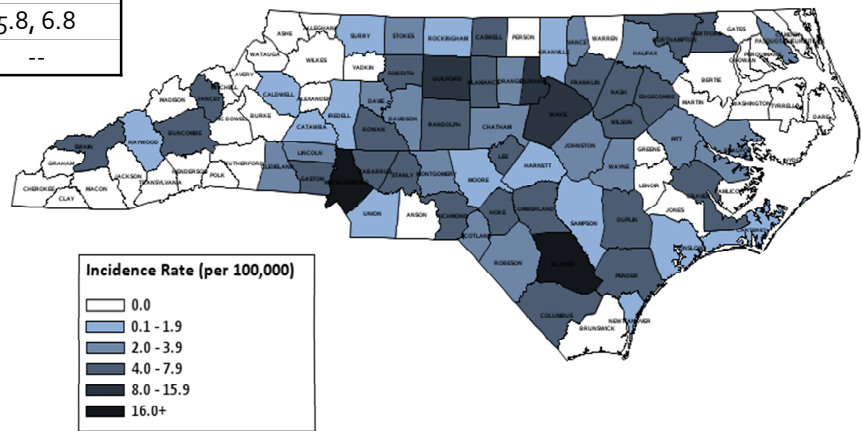
Mpox Cases by Vaccination Status, 2022



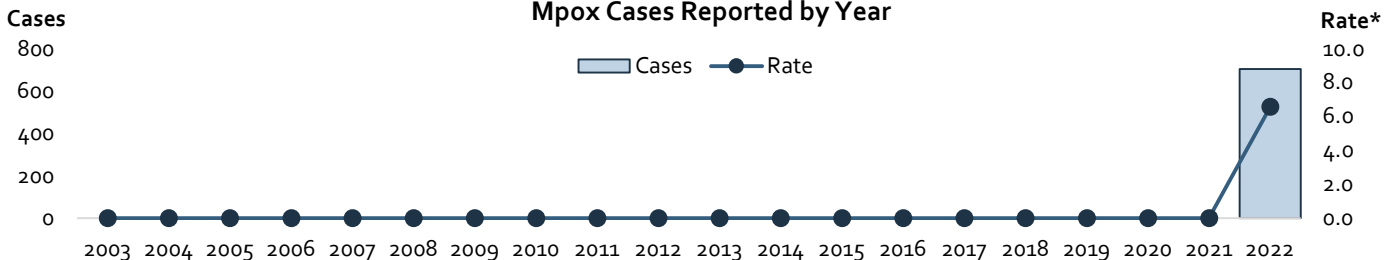
Mpox Cases Reported by Month, 2022



Mpox Incidence Rate by County, 2022



Mpox Cases Reported by Year



*Incidence rate, calculated per 100,000 North Carolina residents

Mumps

Background

Mumps is a viral illness best known for causing swelling of the salivary glands below the ears and above the jaw, called parotitis. Complications are possible from mumps, including orchitis (inflammation of the testicles) in males, oophoritis (inflammation of the ovaries) in females, deafness, and meningitis. People with mumps are considered contagious from two days before to five days after symptoms begin. A significant number of people infected with the mumps virus may not have symptoms (30-40%).

Suspected cases of mumps should avoid contact with others from the time of diagnosis until five days after the onset of parotitis. Suspected cases should stay home from work or school and stay in a separate room from other people if possible. Although not recommended for post-exposure prophylaxis (PEP), susceptible close contacts to mumps cases should be offered vaccine and instructed to monitor for signs and symptoms of mumps. Healthcare workers with unprotected exposure to a mumps patient must show evidence of immunity to mumps or be excluded from work from day 12-25 after exposure.

Vaccination is the best way to prevent mumps. People without evidence of immunity should receive age-appropriate measles-mumps-rubella (MMR) vaccine. People born before 1957 are considered immune based on likely exposure during childhood. Individuals who are unvaccinated are more likely to contract mumps and have complications than individuals who are vaccinated.

Immunization

The live, attenuated mumps vaccine was licensed for use in the United States in 1967. In 1971, the mumps vaccine was licensed as a combined measles, mumps, and rubella (MMR) vaccine. In 2005, a combination measles, mumps, rubella, and varicella (MMRV) vaccine was licensed. Two doses of MMR vaccine are routinely recommended by ACIP for children; the first at 12-15 months, and the second at 4-6 years. Adults born in 1957 or later should receive at least one dose of MMR vaccine unless they have documentation of vaccination with at least one dose of measles, mumps, and rubella-containing vaccine or other acceptable presumptive evidence of immunity. Except for health care personnel, who should have documented immunity, birth before 1957 generally can be considered acceptable evidence of immunity. In North Carolina, one dose of MMR vaccine is required for children on or after 12 months and before 16 months of age, and a second dose is required for students entering school, college, or university for the first time.

Results from the 2022 NIS estimate that 90.1% of children born in 2020 had received at least one dose of MMR vaccine by 24 months of age, compared to 91.4% nationally. Additionally, 96.1% of teens 13-17 years of age were estimated to have received at least two doses of MMR vaccine compared to 91.2% nationally.

Epidemiology

National

Before the U.S. mumps vaccination program began in 1967, about 200,000 cases of mumps were reported each year. Since that time, there has been more than a 99% decrease in mumps cases in the United States. The number of reported cases of mumps nationally spiked during 2016-2019, with an average of over 4,500 cases per year. However, cases decreased again in 2020 and have remained low through 2022. It is possible that control measures implanted in response to the COVID-19 pandemic affected transmission of mumps.

Adolescents and college-aged adults appear to be at increased risk for disease, likely due to close-contact, congregate settings like schools and universities.

North Carolina

Two cases of mumps were reported in 2022, which is equal to 2021, both the lowest number of cases in the state since 2002.

Outbreaks

No outbreaks of mumps were reported in 2022.

Mumps, 2022

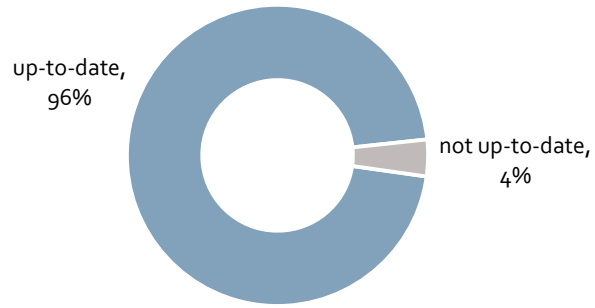
Annual Summary

	2018	2019	2020	2021	2022
Cases	12	89	21	2	2
Rate*	0.1	0.8	0.2	0.0	0.0

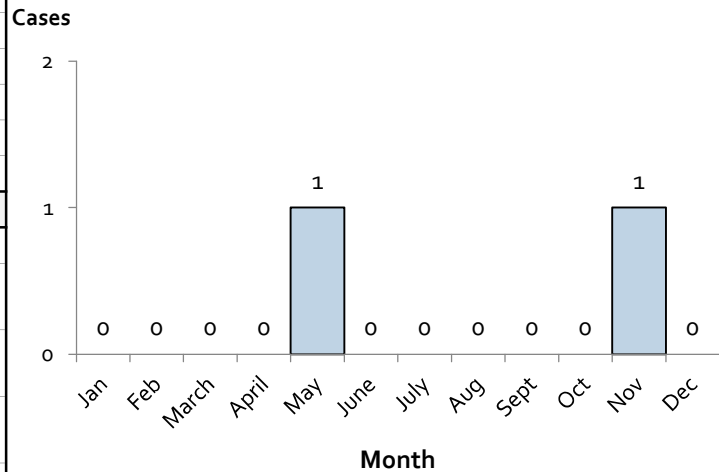
*Cases born before 1957 are considered immune

Case Demographics, 2022				
Sex	Cases	%	Rate*	95% CI
Male	0	0%	0.0	0.0, 0.07
Female	2	100%	0.04	0.0, 0.13
Unknown	0	0%	--	--
Age Group				
Infant	0	0%	0.0	0.0, 3.03
1-4 yrs	0	0%	0.0	0.0, 0.78
5-9 yrs	0	0%	0.0	0.0, 0.59
10-19 yrs	0	0%	0.0	0.0, 0.27
20-49 yrs	1	50%	0.02	0.0, 0.13
50-74 yrs	0	0%	0.0	0.0, 0.12
75+ yrs	1	50%	0.13	0.0, 0.74
Unknown	0	0%	--	--
Race				
White	1	50%	0.01	0.0, 0.07
Black or African American	0	0%	0.0	0.0, 0.16
American Indian / Alaskan Native	0	0%	0.0	0.0, 2.22
Asian or Pacific Islander	1	50%	0.25	0.01, 1.40
Multiple Races	0	0%	0.0	0.0, 1.32
Other or Unknown	0	0%	--	--
Hispanic Ethnicity				
Yes	0	0%	0.0	0.0, 0.33
No	2	100%	0.02	0.0, 0.08
Unknown	0	0%	--	--
Disease Severity				
Hospitalized	1	50%		
Died	0	0%		

North Carolina Youth Ages 13-17 with 2 Doses of MMR Vaccine, 2022



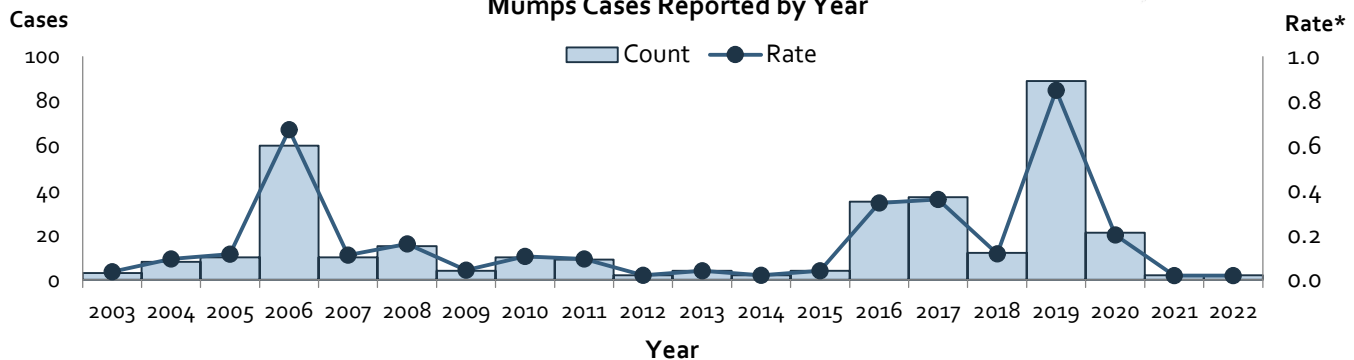
Mumps Cases Reported by Month, 2022



Counties Reporting Mumps, 2022



Mumps Cases Reported by Year



*Incidence rate, calculated per 100,000 North Carolina residents

Pertussis

Background

Pertussis (commonly known as “whooping cough”) is a highly contagious respiratory infection spread from person to person through respiratory droplets from a cough or sneeze or by direct contact with respiratory secretions. Pertussis is primarily a toxin-mediated disease. *Bordetella pertussis* causes disease by attaching to the cilia in the upper respiratory tract and releasing toxins that paralyze the cilia, causing inflammation of the respiratory tract. The incubation period of pertussis ranges from 5-21 days, but typically is 10-14 days. People with pertussis are infectious from the start of symptoms through 3 weeks of cough, or if treated, until completion of appropriate antibiotic treatment.

Pertussis occurs in three disease stages. The first is the catarrhal stage, which generally begins with the gradual onset of runny nose, sneezing and low-grade fever with a mild, occasional cough, similar to the common cold. Next is the paroxysmal stage, characterized by the onset of paroxysms, or uncontrollable fits of coughing. Following one of these fits of coughing, the patient may gasp for air, which can sometimes result in a “whooping” sound. The paroxysmal stage can be quite long with paroxysms increasing in frequency during the first 1-2 weeks and then remaining stable for 2-3 weeks. A gradual recovery begins during the convalescent stage and the coughing fits become less frequent. Secondary infections are most likely to occur during this stage, and paroxysms can recur with later respiratory infections for many months after the onset of pertussis.

Post-exposure prophylaxis (PEP) is recommended for household contacts of pertussis cases, as well as high-risk contacts such as infants, women in the third trimester of pregnancy, and immunocompromised individuals. Azithromycin is the most common choice of antimicrobial used for both treatment of pertussis and PEP.

Immunization

The current tetanus vaccines available in the United States contain the tetanus toxoid, along with acellular pertussis antigens, and diphtheria toxoids (Tdap). Five doses of DTaP are recommended for children at 2, 4, 6, and 15-18 months and 4-6 years by ACIP. One dose of Tdap is recommended for adolescents, preferably at 11-12 years. Tdap is also recommended for pregnant women during the 3rd trimester of each pregnancy to facilitate the transfer of maternal antibodies to the infant. In North Carolina, five doses of DTaP are required, three doses by 7 months and two booster doses, the first by 19 months and the second on or after the fourth birthday and before entering school for the first time. A booster dose of Tdap vaccine is required for 7th grade entry or by 12 years of age, whichever comes first.

According to the 2022 NIS, an estimated 75.7% of North Carolina children born in 2020 had received at least four doses of DTaP by 24 months of age, compared to 80.7% nationally. Alternatively, 91.2% of North Carolina teens aged 13-17 years are estimated to have received at least one dose of Tdap, compared to 89.9% nationally.

Epidemiology

National

In recent years, an increasing burden of disease has been observed in children, likely due to the transition to the acellular pertussis vaccine in the 1990s. Almost 19,000 cases and an incidence rate of 5.67 per 100,000 people occurred in the United States during 2019. However, pertussis cases dropped significantly during the COVID-19 pandemic, with 6,124 reported in 2020 and just 2,116 in 2021. It is likely that control measures and restrictions implemented during the COVID-19 pandemic were effective against preventing transmission of pertussis.

Pertussis is cyclical in nature with peaks occurring every 3-5 years, likely because of an increase in the number of susceptible people accumulating following peak years. Infants are at highest risk of complications and death from pertussis. Secondary bacterial pneumonia is the most common complication in both infants and other age groups.

North Carolina

Just 46 cases of pertussis were reported in North Carolina during 2022, the lowest number since 1992. Four infant cases and zero associated deaths were reported in 2022. The majority of cases were in adults 20 to 74 years old (50%).

Outbreaks

No outbreaks of pertussis were reported during 2022.

Pertussis, 2022

Annual Summary

	2018	2019	2020	2021	2022
Cases	386	496	191	52	46
Rate*	3.7	4.7	1.8	0.5	0.4
Culture confirmed	3%	3%	4%	4%	2%
PCR confirmed	50%	52%	65%	25%	22%
Epi-link confirmed	8%	11%	--†	--†	--†
Probable	38%	33%	30%	71%	76%

Case Demographics, 2022

Sex	Cases	%	Rate*	95% CI
Male	19	41%	0.4	0.2, 0.6
Female	27	59%	0.5	0.3, 0.7
Unknown	0	0%	--	--

Age Group

Age Group	Cases	%	Rate*	95% CI
Infant	4	9%	3.3	0.9, 8.4
1-4 yrs	5	11%	1.1	0.3, 2.5
5-9 yrs	5	11%	0.8	0.3, 1.9
10-19 yrs	6	13%	0.4	0.2, 1.0
20-49 yrs	9	20%	0.2	0.1, 0.4
50-74 yrs	14	30%	0.4	0.2, 0.7
75+ yrs	3	7%	0.4	0.1, 1.2
Unknown	0	0%	--	--

Race

Race	Cases	%	Rate*	95% CI
White	33	72%	0.4	0.3, 0.6
Black or African American	1	2%	0.0	0.0, 0.2
American Indian / Alaskan Native	0	0%	0.0	0.0, 2.2
Asian or Pacific Islander	2	4%	0.5	0.1, 1.8
Multiple Races	0	0%	0.0	0.0, 1.3
Other or Unknown	10	22%	--	--

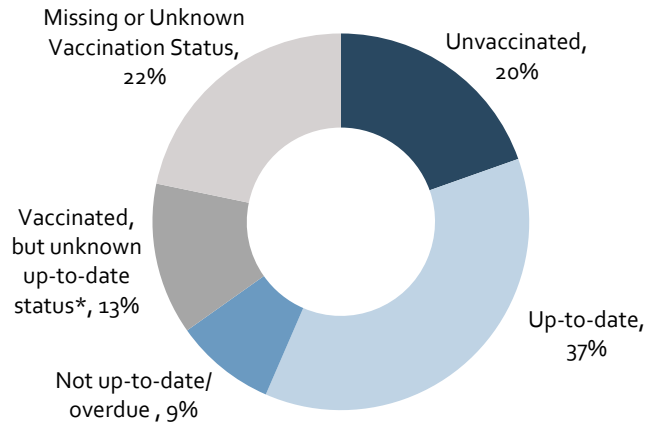
Hispanic Ethnicity

Hispanic Ethnicity	Cases	%	Rate*	95% CI
Yes	4	9%	0.4	0.1, 0.9
No	21	46%	0.2	0.1, 0.3
Unknown	21	46%	--	--

Severity

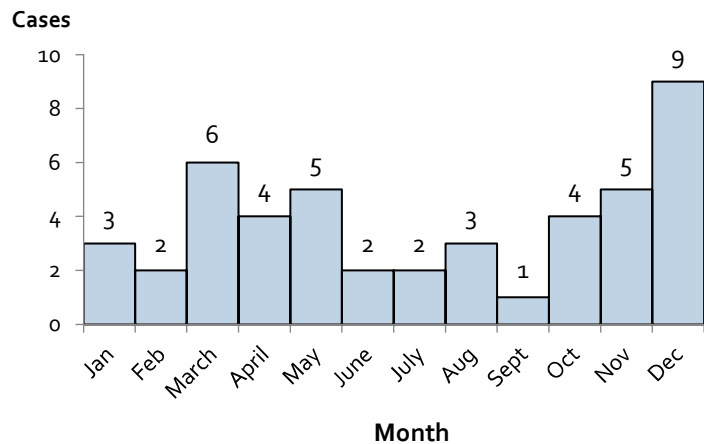
Hospitalization	3	7%
Died	0	0%

Pertussis Cases by Vaccination Status, 2022

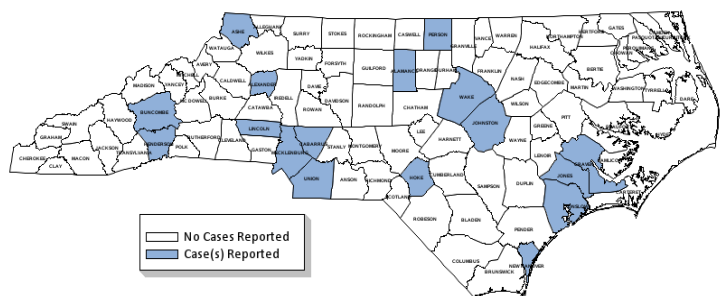


*Vaccinated, but unknown status refers to individuals without documentation referring as to how many doses or date of last Tdap received.

Pertussis Cases Reported by Month, 2022

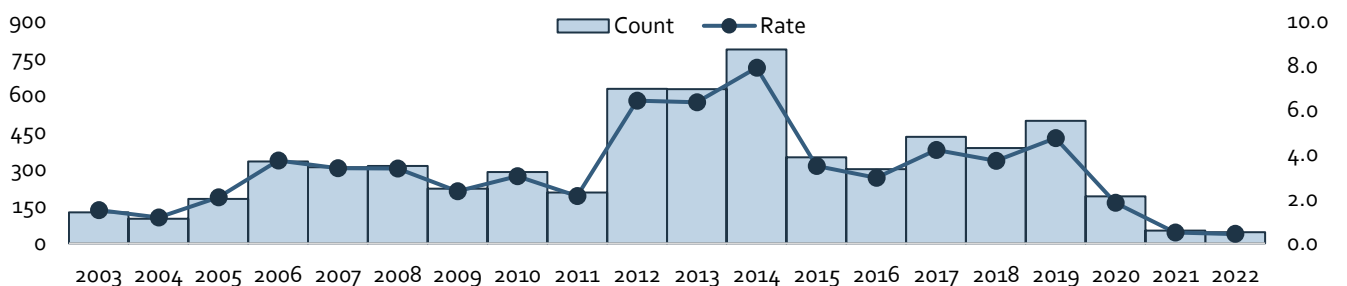


Counties Reporting Pertussis, 2022



Cases

Pertussis Cases Reported by Year



*Incidence rate, calculated per 100,000 North Carolina residents

† Epi-link confirmed cases are no longer accounted for after revision to the case definition in 2020

Pneumococcal Meningitis

Background

Streptococcus pneumoniae (pneumococcus) is a gram-positive bacterium that can cause many clinical syndromes including pneumonia, bacteremia, and meningitis. Pneumococcal meningitis is the only form of invasive disease that is reportable in North Carolina. There are over 90 pneumococcal serotypes, and vaccines are available to protect against those that are most likely to cause invasive disease. Pneumococcal infections are most common during the late winter and early spring.

Transmission of pneumococcus occurs as the result of direct contact with respiratory droplets from an infected person. Certain groups are at higher risk of invasive pneumococcal disease, including children less than two years of age, adults over 65, and people with certain chronic medical conditions. Contacts to people infected with pneumococcus are not generally at increased risk for disease and antibiotic prophylaxis is rarely indicated.

Immunization

PCV15 and PCV20 are conjugate vaccines that protect against 15-20 serotypes most commonly associated with severe infections. PPSV23 is a pneumococcal polysaccharide vaccine and protects against 23 of the most common *S. pneumoniae* serotypes.

Routine vaccination with a series of four PCV15 or PCV20 vaccinations prior to 15 months of age is recommended for all children by ACIP. Pneumococcal vaccination with PCV15 followed by PPSV23 one year later, or a single dose of PCV20 is recommended for all adults over the age of 65. The recommended number of doses for high-risk adults and additional recommendations for catch-up vaccination and vaccination of individuals with certain conditions can be found at the CDC's [website](#). In North Carolina, four doses of PCV vaccine are required for children before 15 months of age.

According to the 2022 NIS, an estimated 89.0% of North Carolina children born in 2020 had received at least four doses of PCV by 24 months of age, compared to 82.1% nationally. Results from the 2021 Behavioral Risk Factor Surveillance System (BRFSS) survey found that 75.2% of North Carolina adults 65 years of age and older had received at least one dose of pneumococcal vaccine, compared to 70.1% nationally.

Epidemiology

National

The first pneumococcal conjugate vaccine, PCV7, was introduced in 2000. Since that time, rates of invasive pneumococcal disease have declined significantly among children less than five years of age, and rates have continued to decline with the use of PCV13 as a routine childhood vaccination.

North Carolina

Rates of pneumococcal meningitis have been consistent in North Carolina for several years. Cases decreased during the first two years of the COVID-19 pandemic but rebounded in 2022; 62 cases were reported during 2022, which was double the cases from 2021. Most cases were hospitalized (97%) and eight (13%) died.

Outbreaks

No outbreaks of pneumococcal meningitis were reported in 2022.

Pneumococcal Meningitis, 2022

Annual Summary

	2018	2019	2020	2021	2022
Cases	44	54	22	25	62
Rate*	0.4	0.5	0.2	0.2	0.6

Case Demographics, 2022

Sex	Cases	%	Rate*	95% CI
Male	27	44%	0.5	0.3, 0.7
Female	35	56%	0.6	0.4, 0.9
Unknown	0	0%	--	--

Age Group

Age Group	Cases	%	Rate*	95% CI
Infant	3	5%	2.5	0.5, 7.2
1-4 yrs	5	8%	1.1	0.3, 2.5
5-9 yrs	2	3%	0.3	0.0, 1.2
10-19 yrs	3	5%	0.2	0.0, 0.6
20-49 yrs	13	21%	0.3	0.2, 0.5
50-74 yrs	31	50%	1.0	0.7, 1.4
75+ yrs	5	8%	0.7	0.2, 1.5
Unknown	0	0%	--	--

Race

Race	Cases	%	Rate*	95% CI
White	27	44%	0.4	0.2, 0.5
Black or African American	21	34%	0.9	0.5, 1.4
American Indian / Alaskan Native	2	3%	1.2	0.1, 4.3
Asian or Pacific Islander	1	2%	0.3	0.0, 1.4
Multiple Races	1	2%	0.4	0.0, 2.0
Other or Unknown	10	16%	--	--

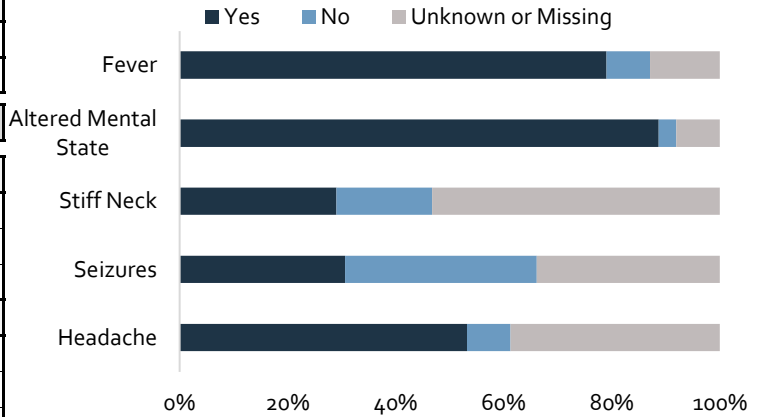
Hispanic Ethnicity

Hispanic Ethnicity	Cases	%	Rate*	95% CI
Yes	7	11%	0.0	0.3, 1.3
No	49	79%	0.0	0.4, 0.7
Unknown	6	10%	--	--

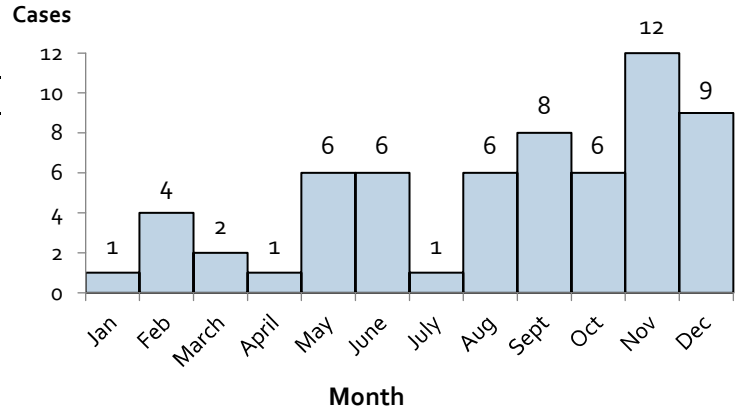
Severity

Hospitalized	60	97%
Died	8	13%

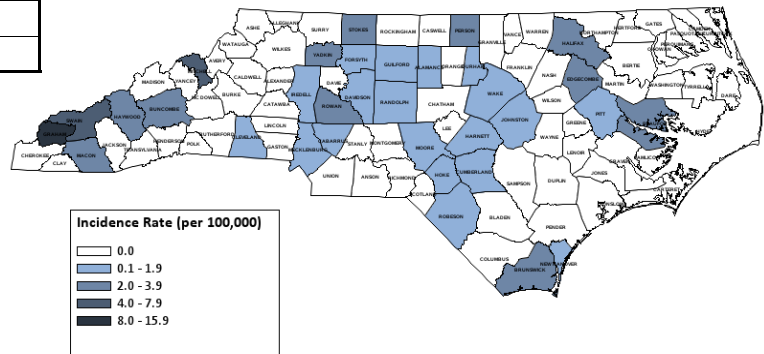
Pneumococcal Meningitis Case Clinical Symptoms, 2022



Pneumococcal Meningitis Cases Reported by Month, 2022



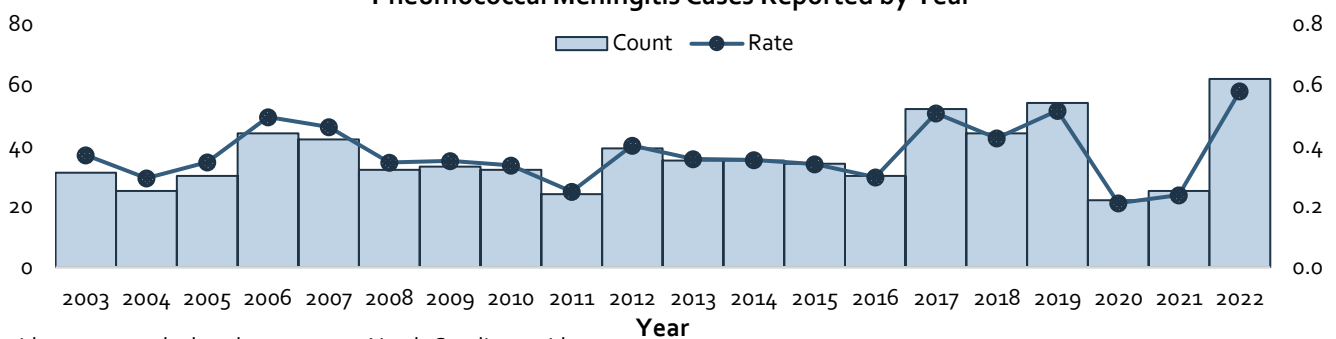
Pneumococcal Meningitis Incidence Rate by County, 2022



Cases

Pneumococcal Meningitis Cases Reported by Year

Rate*



*Incidence rate, calculated per 100,000 North Carolina residents

Tetanus

Background

Tetanus infections are caused by spores of the bacterium *Clostridium tetani*, which are present naturally in the environment and are widespread in dust, soil, and manure. Spores thrive in anaerobic conditions, meaning that they can grow in environments without oxygen. When spores are introduced into dead tissue or deep wounds, they germinate into full-grown bacteria and secrete tetanus toxin, which causes disease.

Certain types of wounds are more likely to become infected with tetanus bacteria because of the anaerobic conditions present. Deep puncture wounds (e.g. stepping on a nail), burn wounds, or crush injuries that are contaminated with dust or dirt are at higher risk of becoming infected than shallow wounds. The incubation period for tetanus is generally two to 14 days but can range from one day to several months. The timing of illness onset is associated with how quickly the spores bind to and are absorbed by the body, which can depend on how heavily contaminated the wound is and the location and depth of the wound. Tetanus is not transmitted from person to person.

Symptoms of tetanus include jaw cramping (lockjaw), painful muscle spasms and stiffness, headache, and fever. Serious complications can occur, including seizures, broken bones, difficulty breathing, and death.

Wound care, along with post exposure use of tetanus immune globulin (TIG) or tetanus toxoid-containing vaccine is recommended for both prophylaxis in wound management and the treatment of tetanus. Prompt administration of antibiotics and TIG have the ability to treat tetanus infections.

Immunization

Tetanus vaccines are combined with vaccines for diphtheria and pertussis (DTaP and Tdap). ACIP recommends five doses of DTaP for children at 2, 4, 6, and 15-18 months and 4-6 years. One dose of Tdap is recommended for adolescents, preferably at 11-12 years, and should be followed by a dose of Td vaccine (excludes the pertussis component) or Tdap every ten years. In North Carolina, five doses of DTaP are required, three doses by age seven months and two booster doses, the first by age 19 months and the second on or after the fourth birthday and before entering school for the first time. A booster dose of Tdap is required for seventh grade entry or by 12 years of age, whichever comes first.

According to the 2022 NIS, an estimated 75.7% of North Carolina children born in 2020 had received at least four doses of DTaP by 24 months of age, compared to 80.7% nationally. Alternatively, 93.8% of North Carolina teens aged 13-17 years had received at least one dose of Tdap or Td, compared to 91.7% nationally.

Epidemiology

National

Cases of tetanus have declined by 95% since the disease began to be reported in 1947, and deaths have been reduced by 99%. Sporadic cases of tetanus still occur in individuals who are not up-to-date on their tetanus vaccination. Tetanus generally peaks in the summer months or during the wet season, depending on the geographical climate.

North Carolina

Just one case of tetanus was reported in North Carolina during 2022, which was similar to the previous five-year average. These low numbers are due to proper wound management and proper vaccine recommendation and uptake. The 2022 tetanus case occurred in a person who was not previously vaccinated but received a dose of TIG seven days after the injury, and the patient survived the diagnosis.

Although it is rare in North Carolina, any tetanus infection emphasizes the need for strong vaccination recommendations for people who are not up-to-date or who are unsure of their vaccination status.

Outbreaks

Because individuals infected with *C. tetani* do not have an infectious period, outbreaks are extremely rare but have been documented during natural disasters when the risk for severe wounds greatly increases. North Carolina has no known tetanus outbreaks to date.

Varicella

Background

Varicella (chickenpox) is a viral illness best known for causing an itchy, blister-like rash that can spread over the entire body. Varicella is caused by the varicella-zoster virus (VZV). In addition to the rash, symptoms may include fever and headache. Although rare, severe complications like skin infections, pneumonia, and encephalitis can occur. People with varicella are considered contagious from 1-2 days before the rash appears until all the skin lesions are crusted over, which typically takes 4-6 days after the onset of the rash.

Suspected cases of varicella should stay home from work or school until all skin lesions are crusted over. Exposure to an infectious person is defined as a) direct contact with respiratory or nasal secretions, b) face-to-face exposure within three feet, and c) sharing the same confined space in close proximity. People exposed to varicella who do not have evidence of immunity should receive the varicella vaccine within five days of exposure. Susceptible people who are at high-risk for severe disease, including immunocompromised children and pregnant women, should receive varicella immunoglobulin.

Vaccination is the best way to prevent varicella. People without evidence of immunity should receive age-appropriate varicella vaccine. People born before 1980 are considered immune based on likely exposure during childhood. Individuals who are unvaccinated are more likely to contract varicella and have complications than individuals who are vaccinated.

Immunization

Two doses of varicella vaccine are routinely recommended for children by ACIP; the first at 12-15 months, and the second at 4-6 years. The varicella vaccine is commonly given with the measles-mumps-rubella vaccine in the MMRV combination vaccine. Additionally, a recombinant zoster vaccine is recommended for adults aged 50 years and older which includes two doses administered at least 6 months apart. In North Carolina, children are required to have two doses of varicella vaccine, one on or after 12 months and before 19 months of age and a second before entering school for the first time.

Results from the 2022 NIS estimate that 87.9% of North Carolina children born in 2020 had received at least one dose of varicella vaccine by 24 months of age, compared to 91.2% nationally. According to the 2021 BRFSS results, 50.7% of North Carolina adults aged 65 years and older were estimated to have received at least one dose of zoster vaccine, compared to 45.7% nationally.

Epidemiology

National

Before the vaccine was developed, varicella was a common childhood illness. The varicella vaccination program began in 1995 and has been a great success, reducing the number of annual cases in the United States by approximately 96%. Chickenpox is now rare in the United States, although outbreaks continue to occur among in child care and school settings. Outbreaks are typically smaller in size and shorter in duration compared to outbreaks that occurred before the vaccine was available.

North Carolina

Varicella became reportable in North Carolina in mid-2020. In 2022, 98 cases of varicella were reported; the majority of cases among infants (23%) and adults ages 20 - 49 years old (21%). The infant incidence rate was 38x higher than adults 20 - 49 years old (18.9 compared to 0.5 per 100,000, respectively). Overall, 10 cases were hospitalized for their illness, but no varicella deaths were reported in 2022.

Outbreaks

There was one outbreak of varicella reported in 2022. The outbreak occurred in a child care facility and ended with 10 total cases; seven cases among child care attendees and three among staff members. Although not a reportable condition, it has been found that adult cases of shingles may contribute to outbreaks in child care settings.

Varicella, 2022

Annual Summary

Year †	2018	2019	2020	2021	2022
Cases	--	--	13	32	98
Rate*	--	--	0.12	0.30	0.92

Case Demographics, 2022

*Cases born before 1980 are considered immune

Sex	Cases	%	Rate*	95% CI
Male	52	53%	1.0	0.7, 1.3
Female	45	46%	0.8	0.6, 1.1
Unknown	1	1%	--	--

Age Group

Age Group	Cases	%	Rate*	95% CI
Infant	23	23%	18.9	12.0, 28.4
1-4 yrs	16	16%	3.4	1.9, 5.5
5-9 yrs	17	17%	2.7	1.6, 4.4
10-19 yrs	13	13%	1.0	0.5, 1.6
20-49 yrs	21	21%	0.5	0.3, 0.8
50-74 yrs	7	7%	0.2	0.1, 0.5
75+ yrs	1	1%	0.1	0.0, 0.7
Unknown	0	0%	--	--

Race

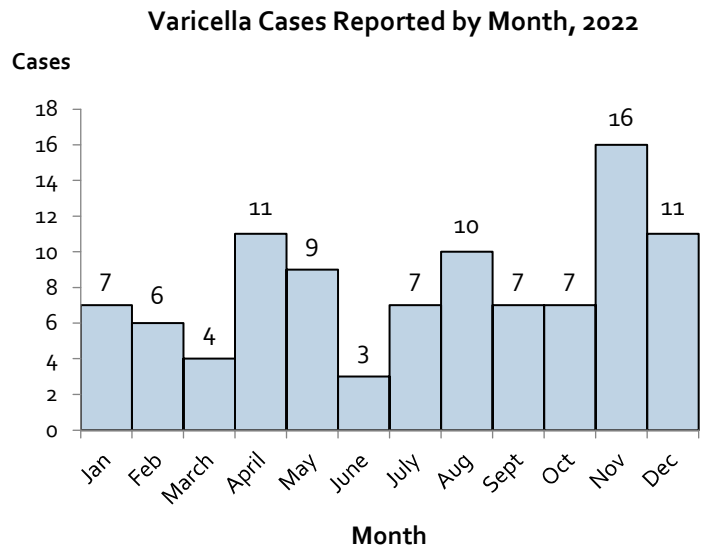
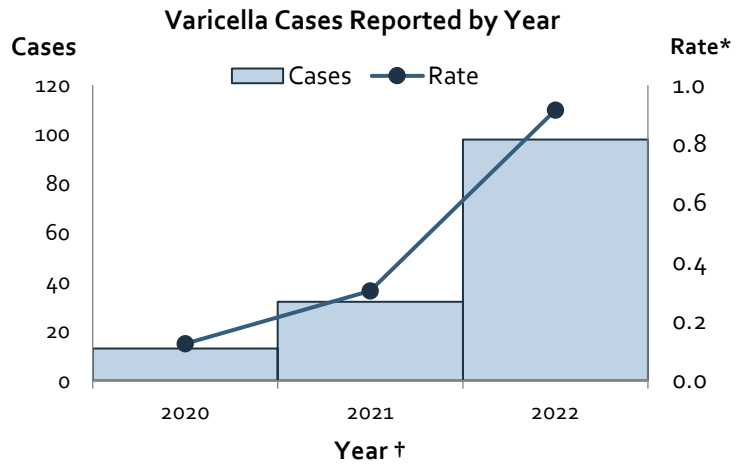
Race	Cases	%	Rate*	95% CI
White	60	61%	0.8	0.6, 1.0
Black or African American	8	8%	0.3	0.1, 0.7
American Indian / Alaskan Native	1	1%	0.6	0.0, 3.4
Asian or Pacific Islander	2	2%	0.5	0.1, 1.8
Multiple Races	0	0%	0.0	0.0, 1.3
Other or Unknown	27	28%	--	--

Hispanic Ethnicity

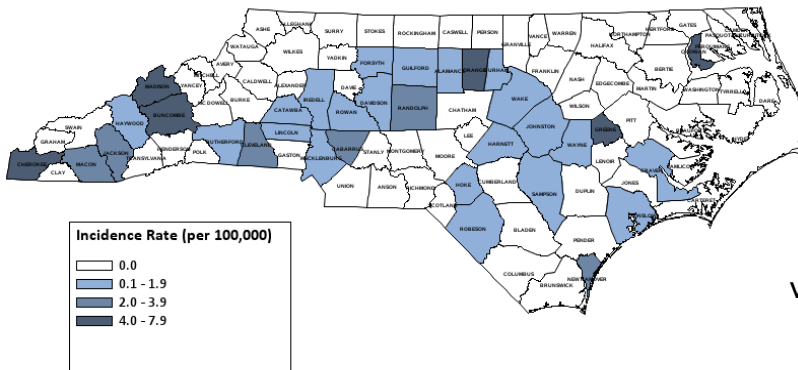
Hispanic Ethnicity	Cases	%	Rate*	95% CI
Yes	23	23%	2.0	1.3, 3.1
No	55	56%	0.6	0.4, 0.7
Unknown	20	20%	--	--

Severity

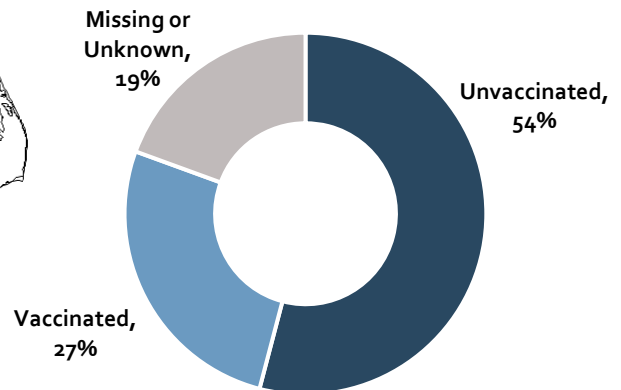
Hospitalized	10	10%
Died	0	0%



Varicella Incidence Rate by County, 2022



Varicella Cases by Vaccination Status, 2022



† Varicella became a reportable condition in 2020; therefore, historical data is not available

*Incidence rate, calculated per 100,000 North Carolina residents