Vaccine-Preventable Diseases Reported in North Carolina, 2016

Controlling vaccine-preventable diseases (VPDs) requires the 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 are at or near record low levels, maintaining high immunization rates is still critical to prevent reemergence. This annual surveillance report summarizes 12 VPDs reported in North Carolina during 2016 in the table below. Additional details about diseases for which cases were reported are presented on subsequent pages.

Report Specifications. Notable information about this report includes:

- Cases presented include those classified as confirmed or probable.
- Case counts are based on the earliest date of illness identification, typically onset date. Therefore, case counts in this report may differ from those included in national summaries, which can be based either on the earliest date of illness identification or on the date when cases were closed and reported to the Centers for Disease Control and Prevention.
- Unless otherwise noted, ages are based on date when the case was entered in the North Carolina Electronic Disease Surveillance System.
- Incidence rates are based on mid-year population estimates obtained from the North Carolina Office of State Budget and Management. Rates for 2016 were calculated using 2015 population estimates. The Hispanic population was estimated to be 9.1% of the total North Carolina population based on 2015 United States Census Bureau data.
- 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.
- The 12 VPDs summarized in this report are shown in the table below. Data for other VPDs reportable in North Carolina, including influenza and hepatitis B, are shown in separate reports.

Surveillance Overview. Two diseases increased significantly compared to the average of the previous five years (2011-2015): hepatitis A and mumps. Cases of invasive *Haemophilus influenzae* continued to increase, but only three were attributable to type b, the only type that is covered by the vaccine. The number of pertussis cases continued to decrease; 300 pertussis cases were reported, the lowest since 2011. No cases of diphtheria, polio, rubella, congenital rubella syndrome, or tetanus were reported.

Number of Cases of VPDs Reported in North Carolina, 2011-2016

Disease	*2011*	*2012*	*2013*	*2014*	*2015*	*Five-year average*	*2016*	*Significant Change**
Diphtheria	0	0	0	0	0	*0*	0	--
Haemophilus influenzae, invasive disease	92	102	140	141	169	*129*	180	--
Hepatitis A	29	38	42	43	39	*38*	52	⇧
Measles	1	0	22	1	0	*5*	1	--
Meningococcal invasive disease	16	8	9	10	5	*10*	5	--
Mumps	9	2	4	2	4	*4*	35	⇧
Pertussis	206	626	625	785	347	*518*	300	--
Pneumococcal meningitis	24	39	35	35	34	*33*	30	--
Polio	0	0	0	0	0	*0*	0	--
Rubella	1	0	0	0	0	*0*	0	--
Congenital rubella syndrome	0	0	0	0	0	*0*	0	--
Tetanus	0	0	0	0	3	*1*	0	--

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

Haemophilus influenzae, Invasive Disease

Background

Haemophilus influenzae, or "H. flu", can cause a variety of clinical syndromes, including invasive diseases like bacteremia, pneumonia, meningitis, and epiglottitis. H. flu 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 influenza serotype b (Hib) is the most virulent and is the only serotype for which there is a vaccine.

H. flu 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. flu 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 5 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 cognitive disabilities. 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. Hib vaccine is currently a recommended routine childhood vaccine in the United States. Infants should receive 3 or 4 doses (depending on the type of vaccine) by 15 months of age. There are no vaccines for non-b or nontypeable H. flu.

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. flu. The majority of invasive H. flu infections are now caused by nontypeable strains and primarily affect children under 5 years of age and adults over 50 years of age.

North Carolina

The number of H. flu cases in North Carolina has increased in recent years. In 2016, 180 cases were reported, the most since 1990 and more than double the number reported in 2008. The reason for this trend is unknown.

The large majority of H. flu cases in North Carolina are caused by nontypeable strains. The age groups most affected in North Carolina (0-4 and $\geq$50 years of age) reflect the national trend. Only 2% of cases reported in 2016 were Hib, and none were in the 0-4 years age group.

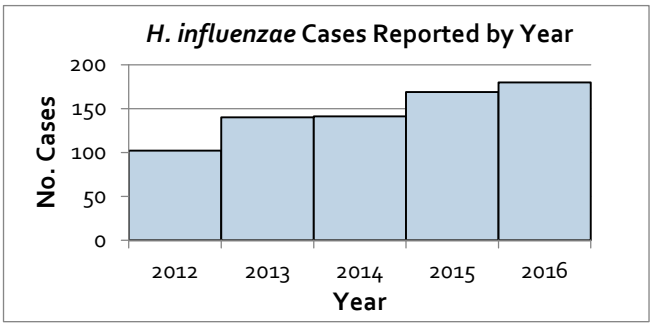
Outbreaks

No outbreaks of H. flu occurred in North Carolina in 2016.

Haemophilus influenzae , invasive disease, 2016

Annual Summary

		2012	2013	2014	2015	2016
Incidence / 100,000		1.1	1.4	1.4	1.7	1.8
No. cases		102	140	141	169	180
Serotypes	*type b, <5 years*	*0%*	*0%*	*0%*	*0%*	*0%*
	type b, ≥ 5 years	*1%*	*2%*	*0%*	*1%*	*2%*
	non-b, typeable	*20%*	*21%*	*24%*	*22%*	*18%*
	nontypeable	*70%*	*66%*	*65%*	*67%*	*72%*
	unknown	*10%*	*11%*	*10%*	*11%*	*8%*



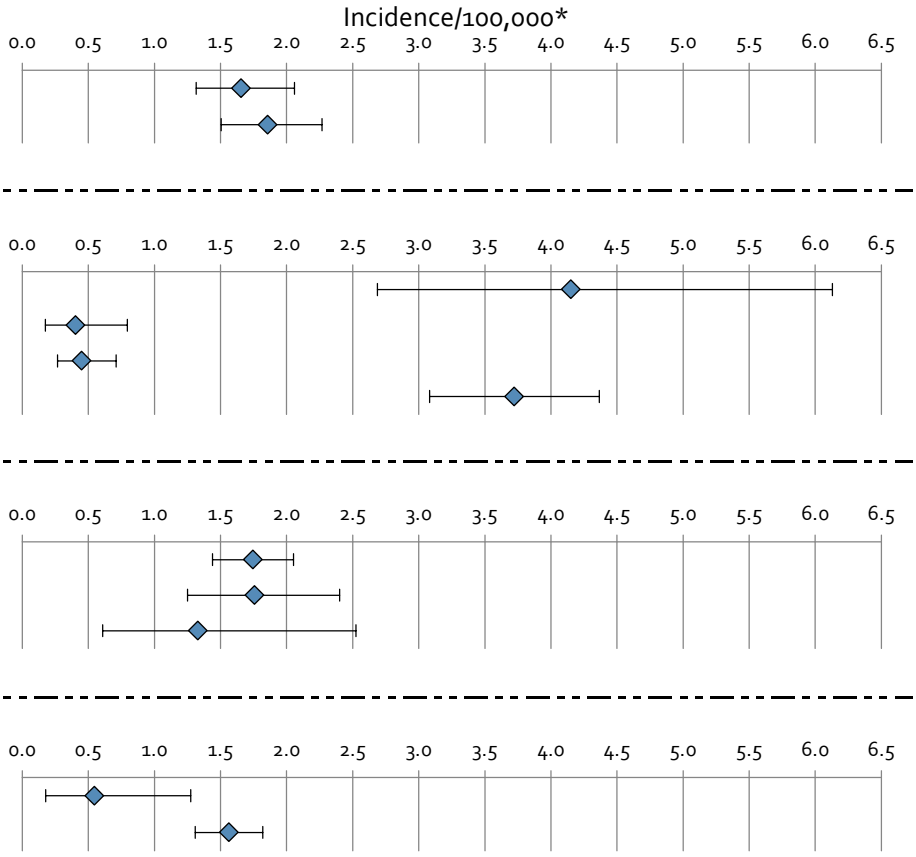
Case Demographics, 2016

Sex	*No. cases*	*% of total*	*Incidence/ 100,000*
Male	81	45%	1.7
Female	96	53%	1.9
Unknown	3	2%	--

Age Group	*No. cases*	*% of total*	*Incidence/ 100,000*
Under 5 yrs.	25	14%	4.2
5-19 yrs.	8	4%	0.4
20-49 yrs.	18	10%	0.4
50+ yrs.	129	72%	3.7
Unknown	0	0%	--

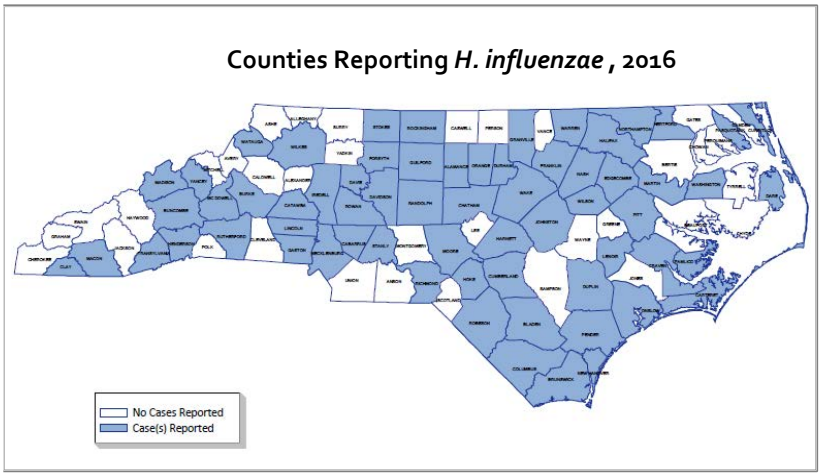
Race	*No. cases*	*% of total*	*Incidence/ 100,000*
White	125	69%	1.7
Black	39	22%	1.8
Other or multiple	9	5%	1.3
Unknown	7	4%	--

Hispanic Ethnicity	*No. cases*	*% of total*	*Incidence/ 100,000*
Yes	5	3%	0.5
No	143	79%	1.6
Unknown	32	18%	--

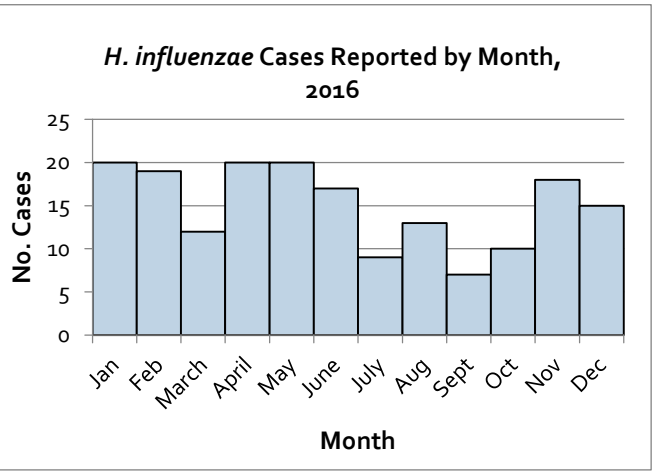


**Point estimates and 95% confidence intervals are shown*

Geographic Distribution



Cases By Month



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 6 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. Persons 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.

Persons with HAV infection are infectious from 2 weeks before jaundice onset to 1 week after. If the patient did not have jaundice, or the jaundice onset date is unknown, the infectious period is considered to be from 1 week before to 2 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. Child care 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. Hepatitis A vaccine is recommended for PEP of contacts who are 1-40 years of age, and vaccine or immune globulin may be recommended for contacts outside this age range. 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 groups such as international travelers, men who have sex with men, and illegal drug users.

Epidemiology

National

There has been a dramatic decrease in hepatitis A infections since vaccine became available in the United States, especially among children. Since 2002, rates among children have declined and are now similar in all age groups. Despite this success, hepatitis A is still a major public health problem. It is one of the most frequently reported diseases nationally, and has a major economic impact because of the cost required to identify contacts and provide PEP.

North Carolina

Reported cases of hepatitis A in 2016 increased compared to the previous 5-year average, but overall remained far lower than cases reported around the turn of the century (an average of 192 cases per year were reported from 1999-2002).

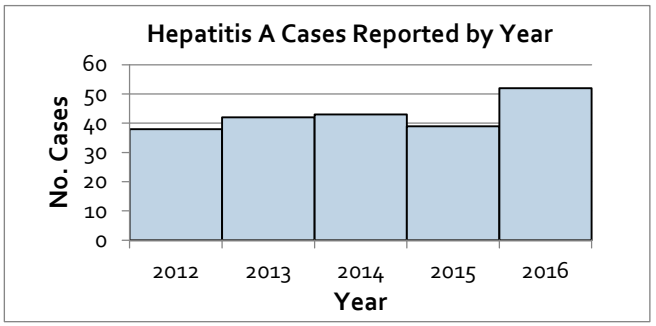
Outbreaks

A major multi-state outbreak of hepatitis A occurred in 2016 associated with consumption of strawberries imported from Egypt. North Carolina identified four cases associated with this outbreak; one case occurred in a person who consumed contaminated strawberries, and three cases occurred in persons epidemiologically linked to an out-of-state case. The majority of cases associated with this outbreak occurred in Virginia residents.

Hepatitis A, 2016

Annual Summary

	2012	2013	2014	2015	2016
Incidence / 100,000	0.39	0.43	0.43	0.39	0.52
No. cases	38	42	43	39	52



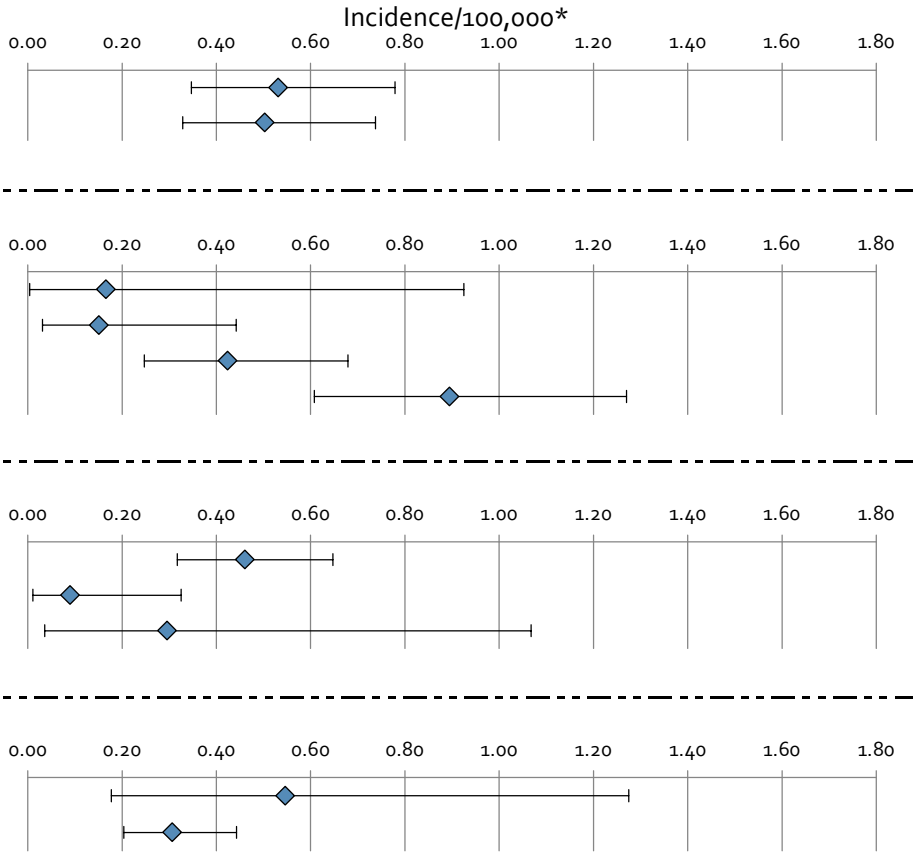
Case Demographics, 2016

Sex	No. cases	% of total	Incidence/ 100,000
Male	26	50%	0.53
Female	26	50%	0.50
Unknown	0	0%	--

Age Group	No. cases	% of total	Incidence/ 100,000
Under 5 yrs.	1	2%	0.17
5-19 yrs.	3	6%	0.15
20-49 yrs.	17	33%	0.42
50+ yrs.	31	60%	0.89
Unknown	0	0%	--

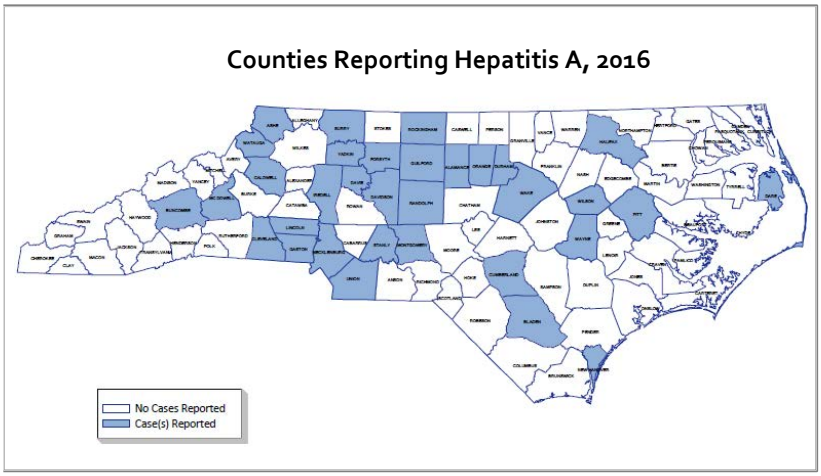
Race	No. cases	% of total	Incidence/ 100,000
White	33	63%	0.46
Black	2	4%	0.09
Other or multiple	2	4%	0.30
Unknown	15	29%	--

Hispanic Ethnicity	No. cases	% of total	Incidence/ 100,000
Yes	5	10%	0.55
No	28	54%	0.31
Unknown	19	37%	--

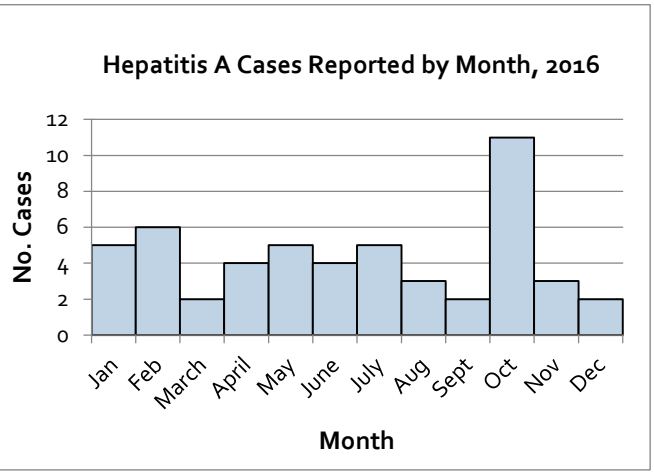


**Point estimates and 95% confidence intervals are shown*

Geographic Distribution



Cases By Month



Measles

Background

Measles is an acute viral illness that is transmitted through airborne droplets or by direct contact with respiratory or throat secretions from an infected person. Measles is characterized by fever, runny nose, red eyes, and a maculopapular rash that first begins on the head and face, and gradually moves down the body and to the extremities. Complications such as pneumonia and encephalitis can occur.

Measles is considered to be one of the most contagious diseases. Any person that shares the same space (e.g. being in the same room) as a measles case is considered exposed to measles. Persons infected with measles are considered contagious from 4 days before the appearance of the rash to 4 days after. Measles-mumps-rubella (MMR) vaccine or immunoglobulin (IG) should be administered to susceptible contacts to prevent infection. Healthcare workers exposed to measles must show evidence of immunity or be excluded from work from day 7-21 after exposure.

Vaccination is the best way to reduce the risk of measles infection and complications. Persons who are unvaccinated are much more likely to be infected with measles and have complications than persons who are vaccinated. Persons without evidence of immunity to measles should be brought up-to-date with age-appropriate vaccination (one or two doses). Persons born before 1957 are considered immune based on likely exposure during childhood.

Immunization

Two doses of MMR vaccine are routinely recommended for children; the first at 12-15 months, and the second at 4-6 years.

Epidemiology

National

Measles rates have declined dramatically since the first vaccine was introduced in the 1960s. Endemic measles was declared eliminated from the United States in 2000. Reported cases remain low nationwide, but cases can be imported from other countries by travelers. The virus can spread rapidly if introduced into a population with low vaccination rates.

North Carolina

Zero to three cases of measles are typically reported in North Carolina each year. The exception to this was an outbreak in 2013, caused by the importation of the disease by a traveler to India. Twenty-two cases and over 1,000 contacts were identified during the course of the investigation.

2016 Case Investigation

One case of measles was identified in North Carolina during 2016. The case occurred in an unvaccinated Wake County resident who returned from a trip to Europe, where measles is endemic. A large contact investigation occurred as a result of this case; almost 400 people were exposed to measles at 11 different community locations in Wake County. MMR vaccine was provided to approximately 100 people who were exposed and 2 individuals received IG. The cost of the investigation was estimated to be over $24,000.

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%. Five serogroups are responsible for the vast majority of invasive disease: A, B, C, Y, and W-135.

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 approximately 7 days before onset until 24 hours after starting appropriate antibiotics. Post-exposure prophylaxis (PEP) should be given within 24 hours after the index patient is identified, if possible. It 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 contains four serogroups (A, C, Y, and W-135). Two doses are recommended for children as part of the routine immunization schedule; the first at 11-12 years, and the second at age 16 years. Vaccination with 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.

Epidemiology

National

Prevention of meningococcal disease is a public health success story. Rates of meningococcal disease in the U.S. have been declining since the 1990s, and are currently at an all-time low. There were 375 cases of meningococcal disease reported nationwide in 2015. Rates are highest in children less than one year age, followed by adolescents and young adults. Serogroup B causes about 60% of cases in children under five years of age, but serogroups C, Y, and W-135 account for the majority of cases in adolescents and adults.

North Carolina

Rates of meningococcal invasive disease are at an all-time low in North Carolina, reflecting the national trend; the incidence rate in 2016 was just 0.05 per 100,000 persons. From 2012-2016, 37 cases of meningococcal invasive disease were identified; serogroup B caused the largest share of infections (38%) followed by serogroup Y (30%).

Outbreaks

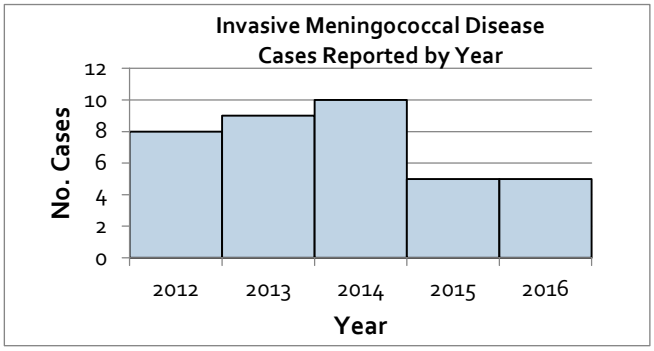
No outbreaks of meningococcal invasive disease occurred in North Carolina during 2016

Meningococcal Invasive Disease, 2016

Annual Summary

		2012	2013	2014	2015	2016
Incidence / 100,000		0.08	0.09	0.10	0.05	0.05
No. of cases		8	9	10	5	5
Serogroups	A	0%	0%	0%	0%	0%
	C	13%	11%	10%	20%	0%
	Y	50%	33%	30%	0%	20%
	W-135	0%	0%	10%	20%	0%
	B	25%	33%	40%	40%	60%
	Unknown	13%	22%*	10%	20%	20%

*1 unknown, 1 could not distinguish between C & W-135



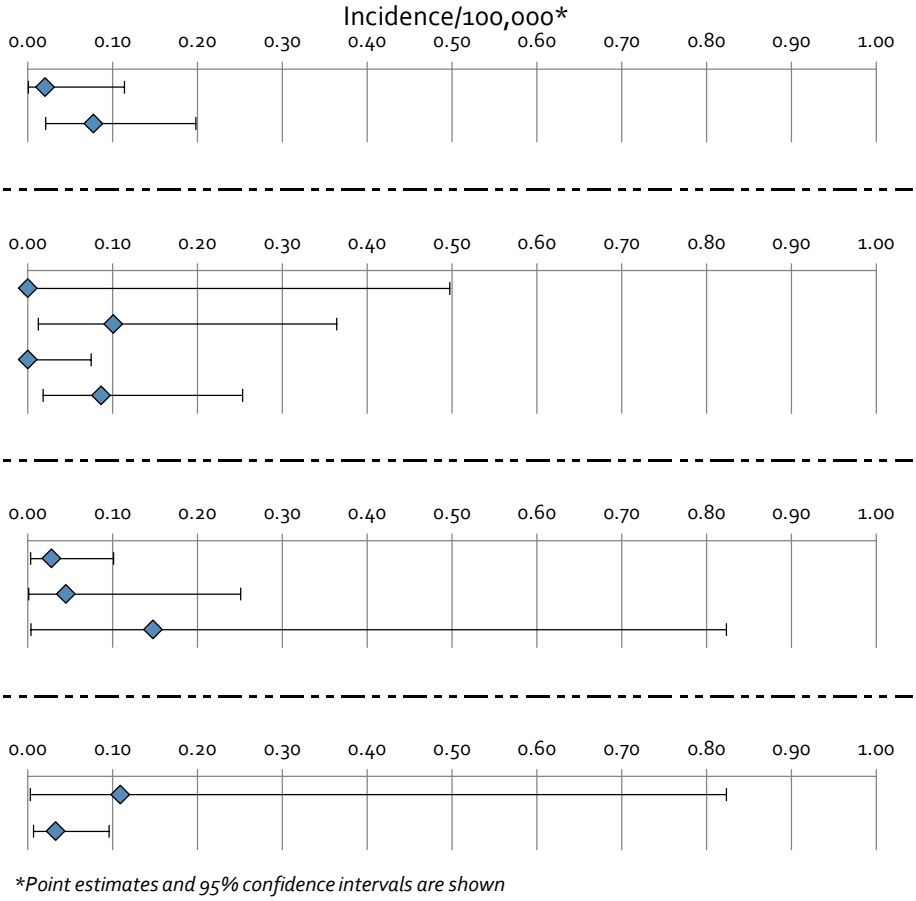
Case Demographics, 2016

Sex	No. cases	% of total	Incidence/ 100,000
Male	1	20%	0.02
Female	4	80%	0.08
Unknown	0	0%	--

Age Group	No. cases	% of total	Incidence/ 100,000
Under 5 yrs.	0	0%	0.00
5-19 yrs.	2	40%	0.10
20-49 yrs.	0	0%	0.00
50+ yrs.	3	60%	0.09
Unknown	0	0%	--

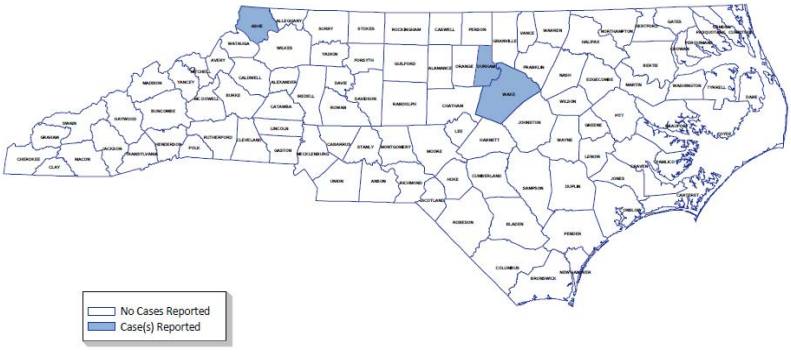
Race	No. cases	% of total	Incidence/ 100,000
White	2	40%	0.03
Black	1	20%	0.05
Other or multiple	1	20%	0.15
Unknown	1	20%	--

Hispanic Ethnicity	No. cases	% of total	Incidence/ 100,000
Yes	1	20%	0.11
No	3	60%	0.03
Unknown	1	20%	--

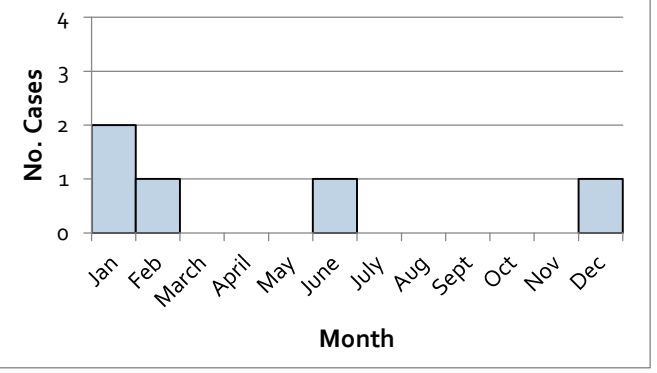


*Point estimates and 95% confidence intervals are shown

Geographic Distribution

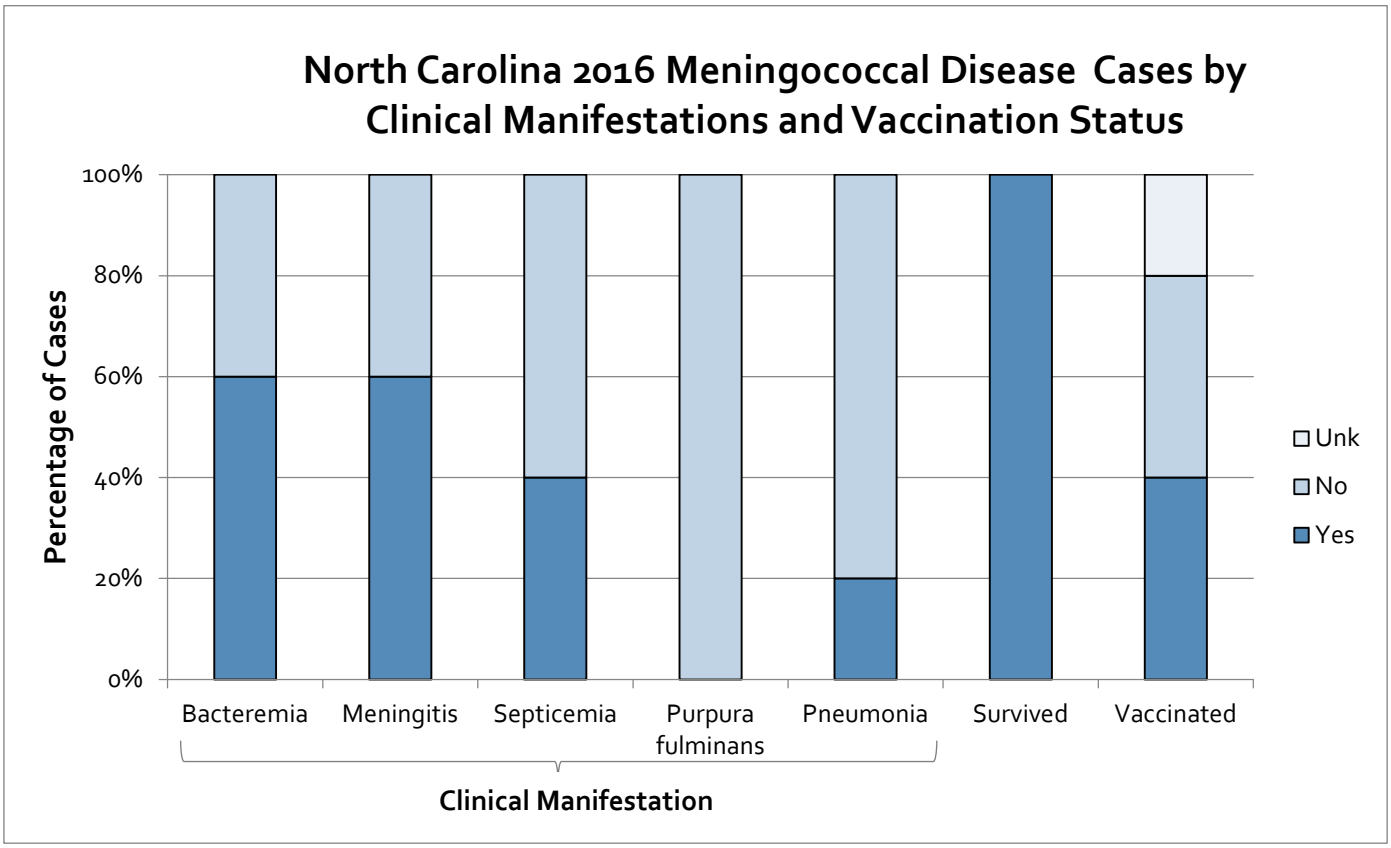


Cases By Month

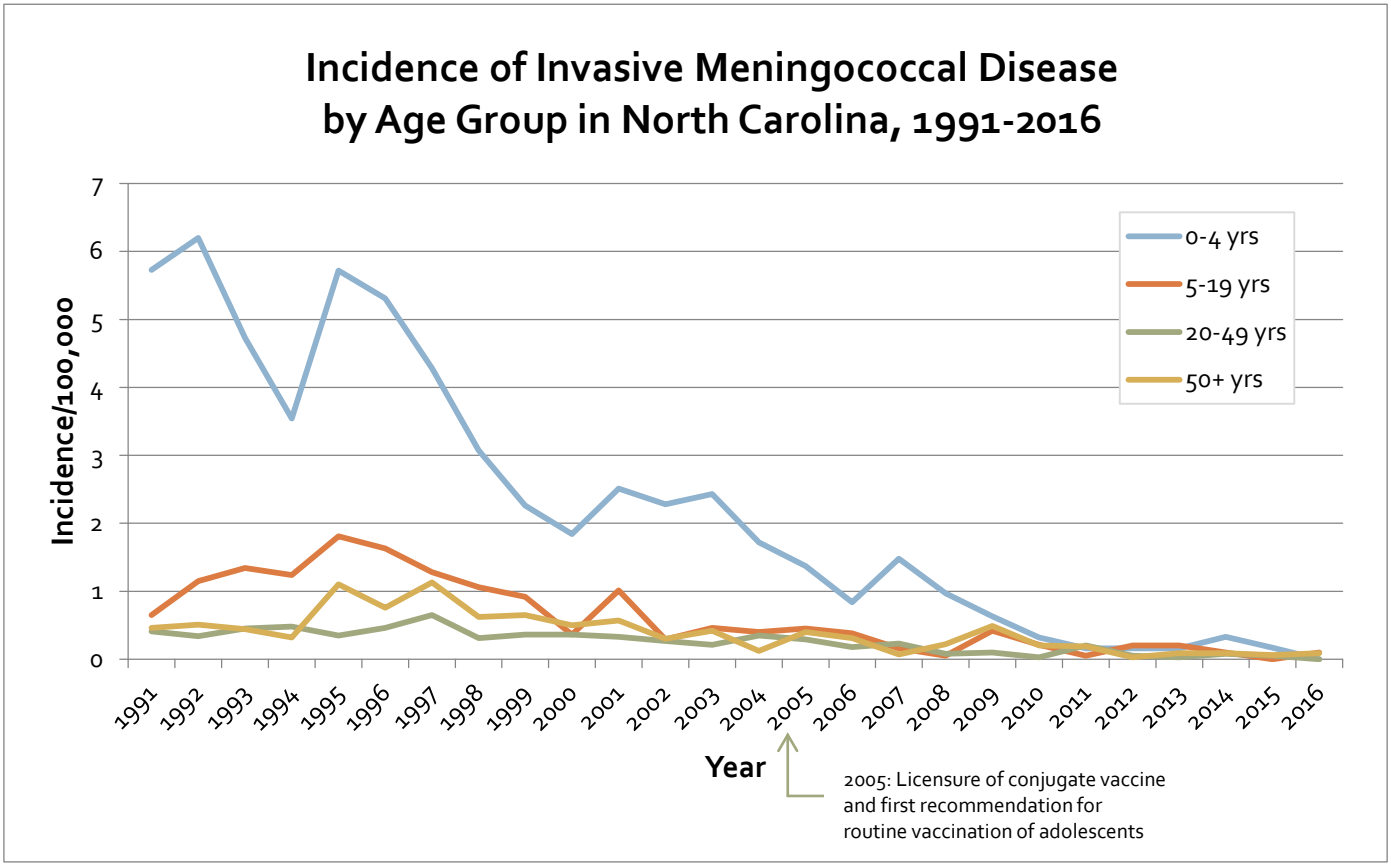


Meningococcal Invasive Disease, 2016 *(continued)*

2016 Case Summary



Meningococcal Disease Incidence by Age Group



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 2 days before to 5 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 5 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. 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. Persons without evidence of immunity should receive age-appropriate measles-mumps-rubella (MMR) vaccine. Persons born before 1957 are considered immune based on likely exposure during childhood. Persons who are unvaccinated are more likely to contract mumps and have complications than persons who are vaccinated.

Immunization

Two doses of MMR vaccine are routinely recommended for children; the first at 12-15 months, and the second at 4-6 years.

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. However, the number of reported cases of mumps has recently spiked, with almost 6,000 cases reported nationwide in 2016. 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

Thirty-five cases of mumps were reported in North Carolina during 2016. The majority of cases were linked to an outbreak in Mecklenburg and Iredell counties (see outbreak description below).

Outbreaks*

A mumps outbreak was identified in February 2016 when a cluster of persons with parotitis was reported to the Iredell County Health Department. An international traveler was identified as the potential source case, and transmission from this patient resulted in 21 additional cases of mumps identified over a six month period.

Cases were identified among workers in an office building in Iredell County, students at the University of North Carolina Charlotte, and community members of the Mecklenburg-Iredell County region. The median age was 28 years, with a range of 19-50 years. The dates of onset of illness ranged from January 10 to June 3, 2016. Twenty-one (95%) persons reported receipt of at least one dose of MMR vaccine prior to the outbreak. No complications due to infection were reported.

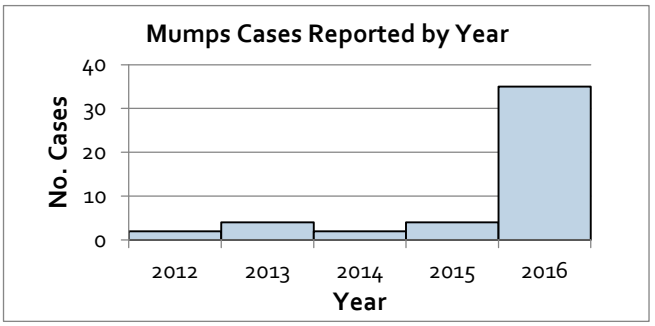
*Data from outbreaks in 2017 are not included in this report

Mumps, 2016

Annual Summary

	2012	2013	2014	2015	2016
Incidence / 100,000	0.02	0.04	0.02	0.04	0.35
No. cases	2	4	2	4	35
Confirmed	*50%*	*0%*	*0%*	*0%*	*31%*
Probable	*50%*	*100%*	*100%*	*100%*	*69%*
*Unvaccinated or unknown immune status**	*50%*	*25%*	*100%*	*0%*	*40%*

**Cases born before 1957 are considered immune*



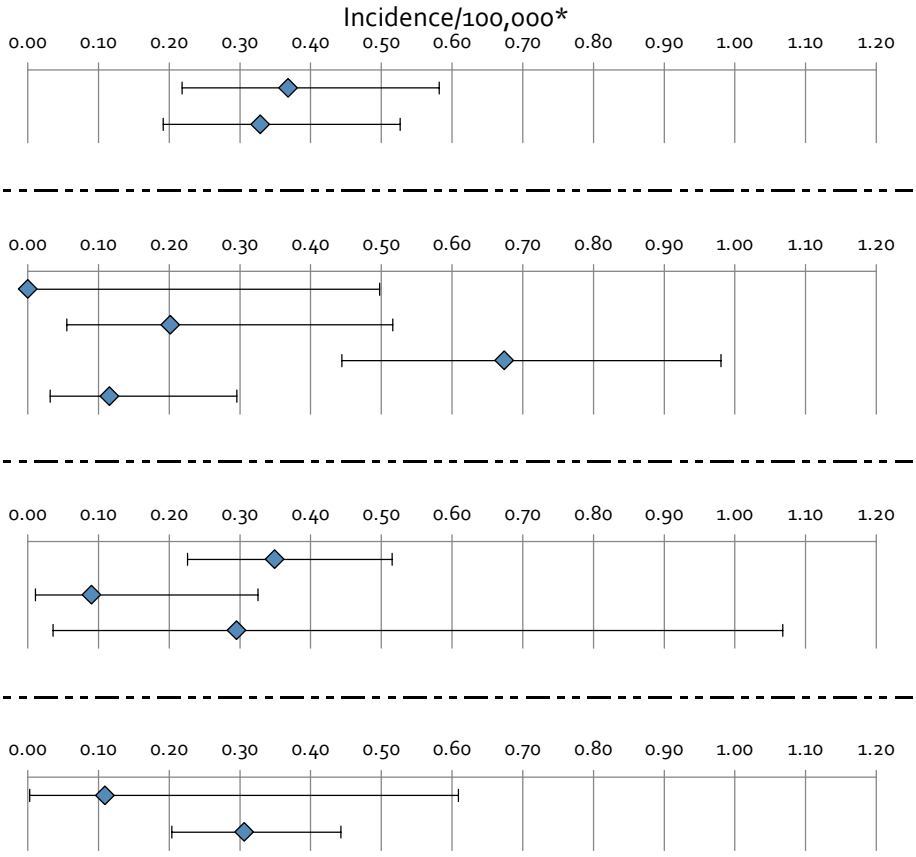
Case Demographics, 2016

Sex	*No. cases*	*% of total*	*Incidence/ 100,000*
Male	18	51%	0.37
Female	17	49%	0.33
Unknown	0	0%	--

Age Group	*No. cases*	*% of total*	*Incidence/ 100,000*
Under 5 yrs.	0	0%	0.00
5-19 yrs.	4	11%	0.20
20-49 yrs.	27	77%	0.67
50+ yrs.	4	11%	0.12
Unknown	0	0%	--

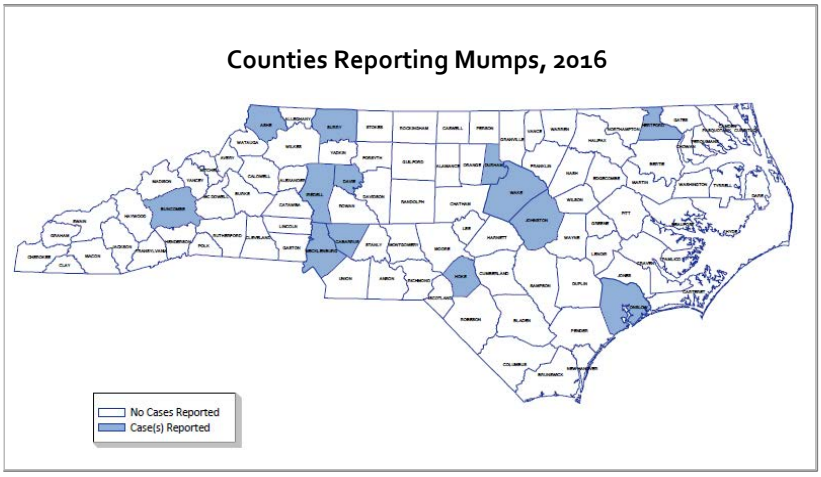
Race	*No. cases*	*% of total*	*Incidence/ 100,000*
White	25	71%	0.35
Black	2	6%	0.09
Other or multiple	2	6%	0.30
Unknown	6	17%	--

Hispanic Ethnicity	*No. cases*	*% of total*	*Incidence/ 100,000*
Yes	1	3%	0.11
No	28	80%	0.31
Unknown	6	17%	--

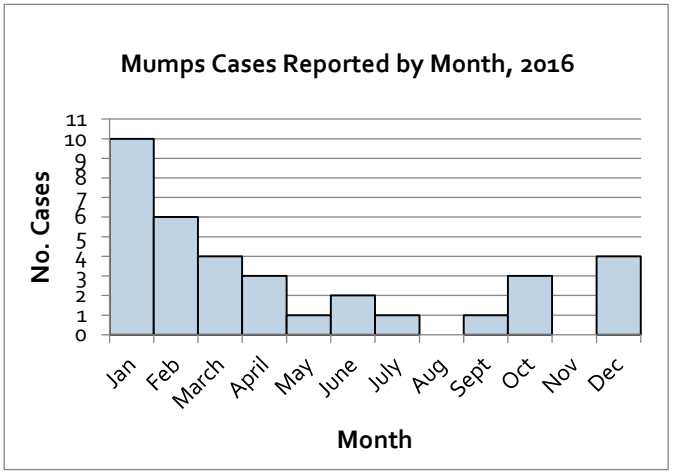


**Point estimates and 95% confidence intervals are shown*

Geographic Distribution



Cases By Month



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 releases 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. Persons with pertussis are infectious from the start of symptoms through 3 weeks of cough, or if treated, until after 5 days of appropriate antibiotics.

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 like infants, women in the third trimester of pregnancy, and immunocompromised persons. Azithromycin is the most common choice of antimicrobial used for both treatment of pertussis and PEP.

Immunization

The current pertussis vaccines available in the United States contain acellular pertussis antigens in combination with tetanus and diphtheria toxoids (DTaP and Tdap). Five doses of DTaP are recommended 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. Tdap is also recommended for pregnant women during the 3rd trimester of each pregnancy, to facilitate the transfer of maternal antibodies to the infant.

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. Since that time, cases have steadily risen, culminating in over 48,000 cases and an incidence rate of 15.4 per 100,000 persons in 2012. Pertussis is cyclical in nature with peaks occurring every 3-5 years, likely because of an increase in the number of susceptible persons 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

Pertussis peaked in North Carolina during 2012-2014, when an average of 679 cases were reported. Transmission has trended downward since that time, with only 300 cases reported in 2016, the lowest since 2011.

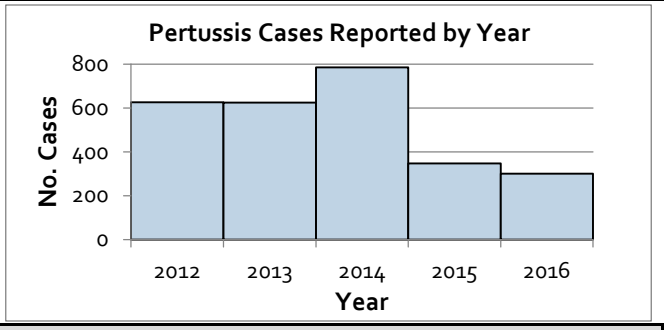
Outbreaks

Two pertussis outbreaks were reported in 2016 in Orange and Union counties. Both outbreaks occurred among school aged children and adolescents.

Pertussis, 2016

Annual Summary

	2012	2013	2014	2015	2016
Incidence / 100,000	6.5	6.4	8.0	3.5	3.0
No. cases	626	625	785	347	300
Culture confirmed	*11%*	*8%*	*7%*	*3%*	*3%*
PCR confirmed	*42%*	*53%*	*44%*	*33%*	*37%*
Epi-link confirmed	*11%*	*10%*	*14%*	*10%*	*8%*
Probable	*37%*	*28%*	*35%*	*54%*	*52%*



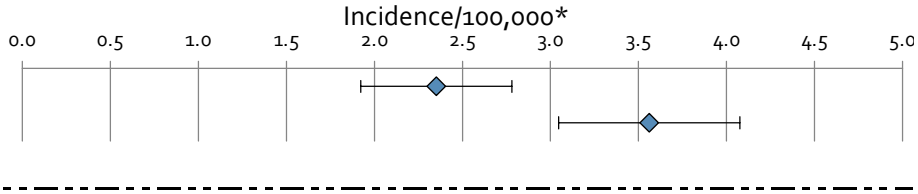
Case Demographics, 2016

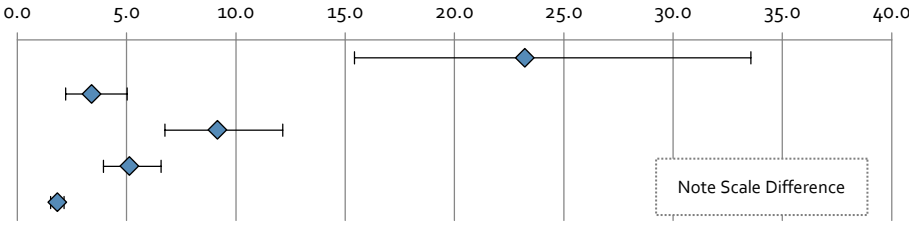
Sex	*No. cases*	*% of total*	*Incidence/ 100,000*
Male	115	38%	2.4
Female	184	61%	3.6
Unknown	1	0%	--

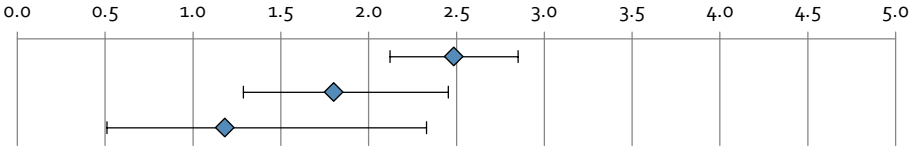
Age Group	*No. cases*	*% of total*	*Incidence/ 100,000*
Infants (<1 yr.)	28	9%	23.2
1-6 yrs.	25	8%	3.4
7-10 yrs.	48	16%	9.2
11-19 yrs.	62	21%	5.1
20+ yrs.	137	46%	1.8
Unknown	0	0%	--

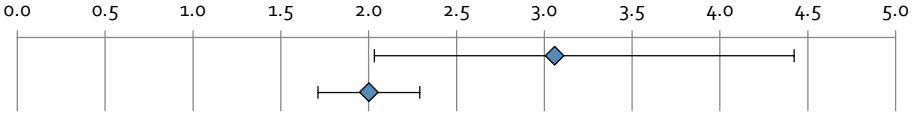
Race	*No. cases*	*% of total*	*Incidence/ 100,000*
White	178	59%	2.5
Black	40	13%	1.8
Other or multiple	8	3%	1.2
Unknown	74	25%	--

Hispanic Ethnicity	*No. cases*	*% of total*	*Incidence/ 100,000*
Yes	28	9%	3.1
No	183	61%	2.0
Unknown	89	30%	--



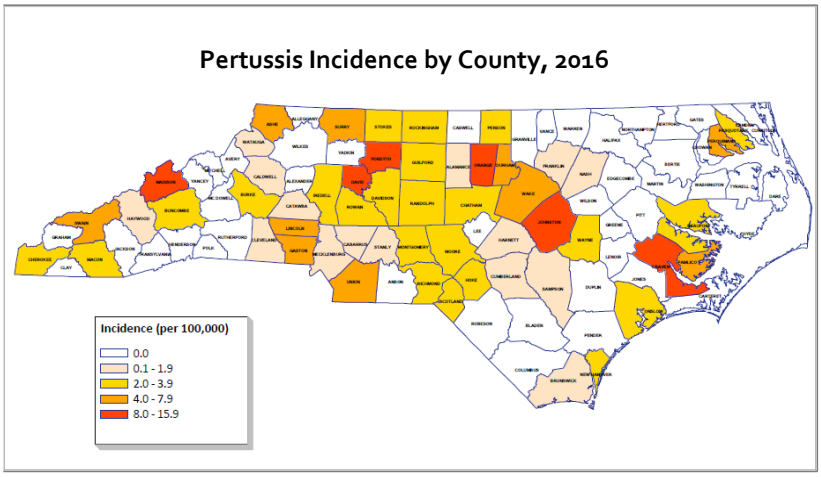




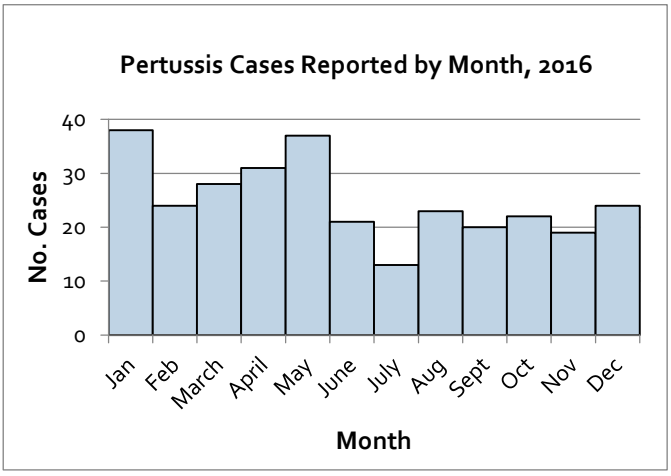


**Point estimates and 95% confidence intervals are shown*

Geographic Distribution

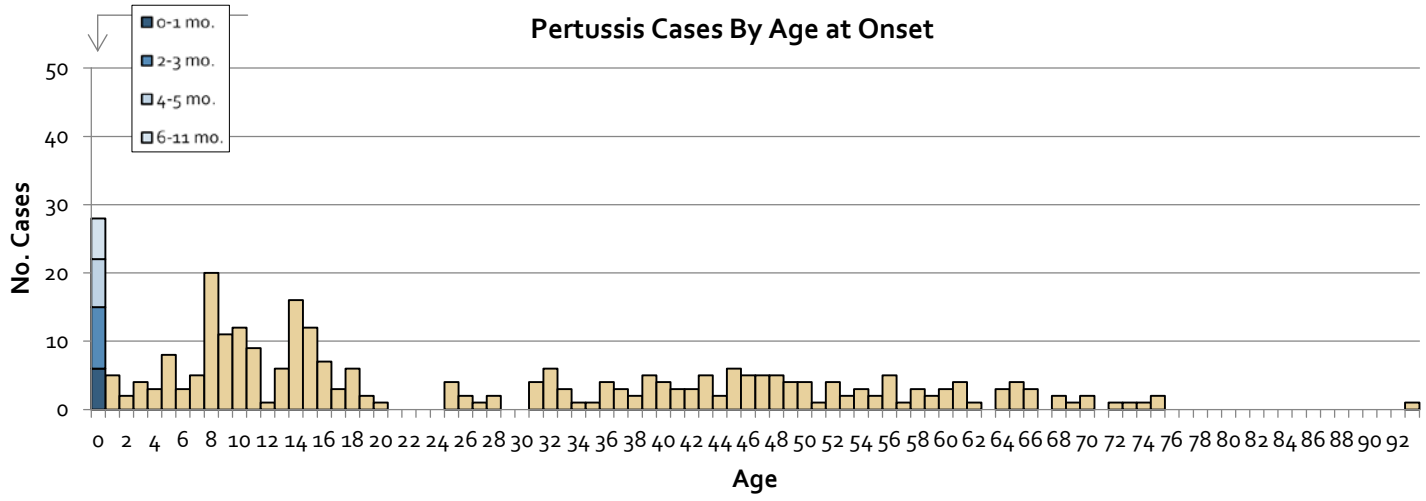


Cases By Month



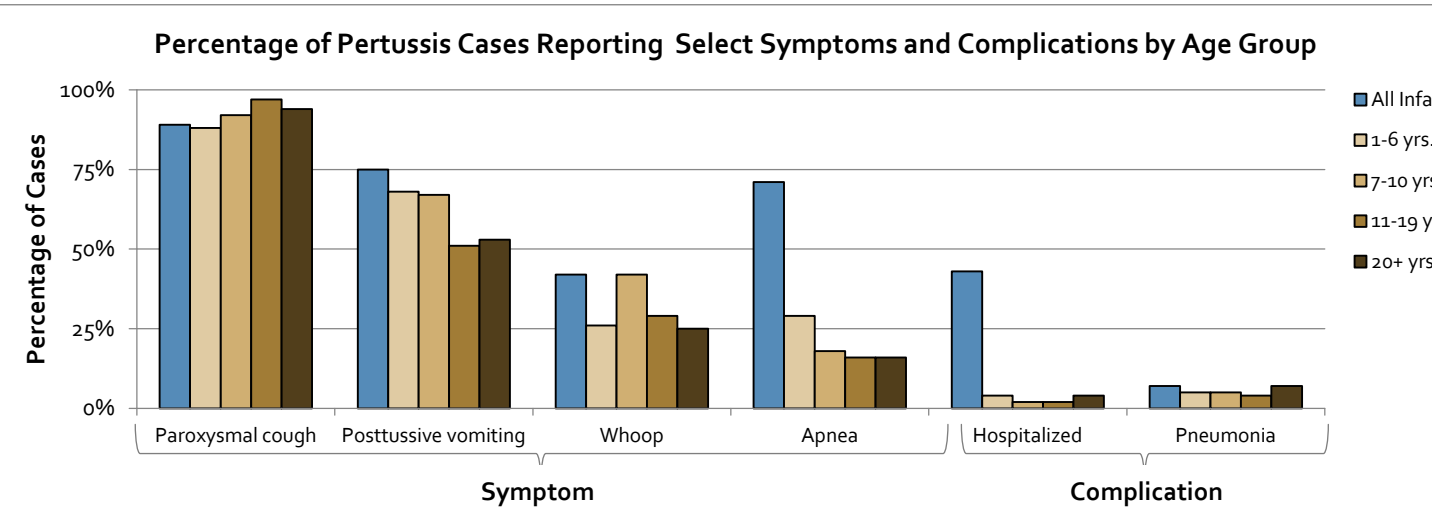
Pertussis, 2016 *(continued)*

Age Distribution



Clinical Information

	Infant Age Groups				Age Groups					All Ages	
	0-1 mo.	2-3 mo.	4-5 mo.	6-11 mo.	All Infants	1-6 yrs.	7-10 yrs.	11-19 yrs.	20+ yrs.		
No. cases	6	9	7	6	28	25	48	62	137	300	
Symptoms (No. cases, % of known responses)											
Paroxysmal cough	6	100%	8	89%	5	71%	6	100%	25	89%	22	88%	44	92%	59	97%	129	94%	279	93%
Posttussive vomiting	5	83%	6	67%	6	86%	4	67%	21	75%	17	68%	32	67%	31	51%	72	53%	173	58%
Whoop	2	40%	4	44%	2	33%	3	50%	11	42%	6	26%	18	42%	17	29%	33	25%	85	28%
Apnea	5	83%	6	67%	5	71%	4	67%	20	71%	7	29%	8	18%	9	16%	21	16%	65	22%
Complications (No. cases, % of known responses)											
Hospitalized	5	83%	3	33%	3	43%	1	17%	12	43%	1	4%	1	2%	1	2%	5	4%	20	7%
Pneumonia	0	0%	2	22%	0	0%	0	0%	2	7%	1	5%	2	5%	2	4%	8	7%	15	1%
Seizures	0	0%	0	0%	0	0%	0	0%	0	0%	1	5%	0	0%	0	0%	0	0%	1	<1%
Encephalopathy	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	1	2%	0	0%	0	0%	1	<1%
Died	0	0%	0	0%	0	0%	0	0%	0	0%	1	4%	0	0%	0	0%	0	0%	1	<1%

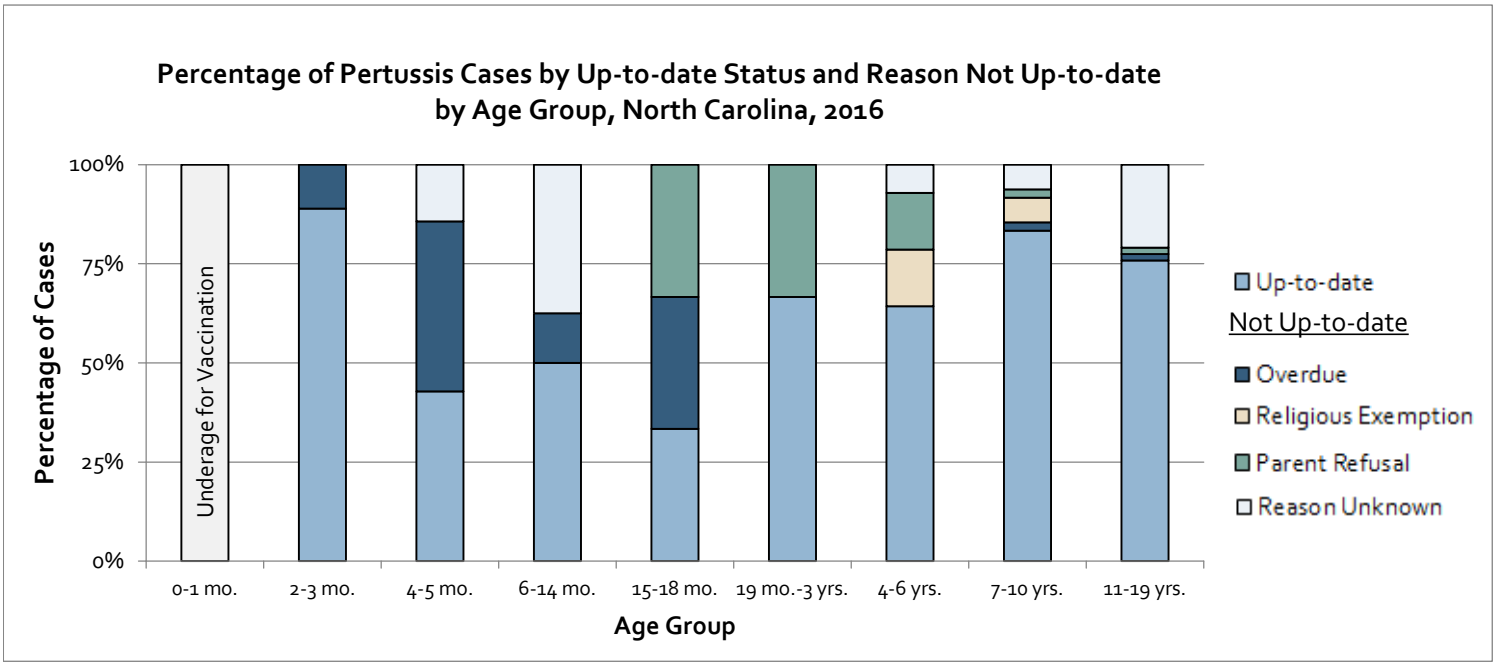


Pertussis, 2016 *(continued)*

Vaccination Status of Children and Adolescents by Age Group*

Age Group	*0-1 mo.*		*2-3 mo.*		*4-5 mo.*		*6-14 mo.*		*15-18 mo.*		*19 mo.-3 yrs.*		*4-6 yrs.*		*7-10 yrs.*		*11-19 yrs.*	
No. of cases	6		9		7		8		3		6		14		48		62	
Vaccine Type	DTaP/DTP																Tdap	
Expected doses	0		1		2		3		3-4		4		4-5		5†		1+	
Documented doses of pertussis-containing vaccine																		
0	6	100%	1	11%	1	14%	1	13%	1	33%	2	33%	4	29%	6	13%	15	24%
1			8	89%	3	43%	0	0%	1	33%	0	0%	0	0%	0	0%	47	76%
2					3	43%	3	38%	0	0%	0	0%	0	0%	0	0%		
3							4	50%	1	33%	0	0%	1	7%	0	0%		
4									0	0%	4	67%	3	21%	2	4%		
5+													6	43%	40	83%		
Unknown	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Up-to-date (of known status)																		
Yes			8	89%	3	43%	4	50%	1	33%	4	67%	9	64%	40	83%	47	76%
No			1	11%	4	57%	4	50%	2	67%	2	33%	5	36%	8	17%	15	24%
Overdue	Underage for Vaccination		*1*	*100%*	*3*	*75%*	*1*	*25%*	*1*	*0%*	*0*	*0%*	*0*	*0%*	*1*	*13%*	*1*	*7%*
Religious Exemption			*0*	*0%*	*0*	*0%*	*0*	*0%*	*0*	*0%*	*0*	*0%*	*2*	*40%*	*3*	*38%*	*0*	*0%*
Parent Refusal			*0*	*0%*	*0*	*0%*	*0*	*0%*	*1*	*100%*	*2*	*100%*	*2*	*40%*	*1*	*13%*	*1*	*7%*
Unknown			*0*	*0%*	*1*	*25%*	*3*	*75%*	*0*	*0%*	*0*	*0%*	*1*	*20%*	*3*	*38%*	*13*	*87%*

**Vaccination data were provided by the NC Immunization Branch. Vaccination history was obtained using documentation provided in NC EDSS or in the North Carolina Immunization Registry. Ages are based on date of symptom onset. †A child aged 7 through 10 years is considered up-to-date if he/she has received five valid DTaP/DTP doses or if his/her fourth DTaP/DTP dose was given on or after the fourth birthday*



Maternal Tdap (for infant cases <1 year of age)

Mother Received Tdap in Association with Case Pregnancy	*No. cases in 2016*	*% of total*
Yes, during pregnancy	10	36%
Yes, postpartum	5	18%
No	11	39%
Unknown	2	7%
Total	**28**	**100%**

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 2 years of age, adults over 65, and people with certain chronic medical conditions. Contacts to persons infected with pneumococcus are not generally at increased risk and antibiotic prophylaxis is rarely indicated.

Immunization

PCV13 is a conjugate vaccine that protects against the thirteen 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 4 PCV13 vaccinations prior to 15 months of age is recommended for all children. Pneumococcal vaccination with PCV13 followed by PPSV23 is recommended for all adult over the age of 65 and for adults aged 18-64 who are at increased risk of infection. 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 at www.cdc.gov/vaccines/vpd/pneumo/hcp/recommendations.html

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 5 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 in North Carolina have remained consistent for many years. No more than 50 cases have been reported in a year since 2001. In 2016, 30 cases were reported, the lowest number since 2011. Only four cases of pneumococcal meningitis occurred among person aged 65 or older; none had documentation of vaccination.

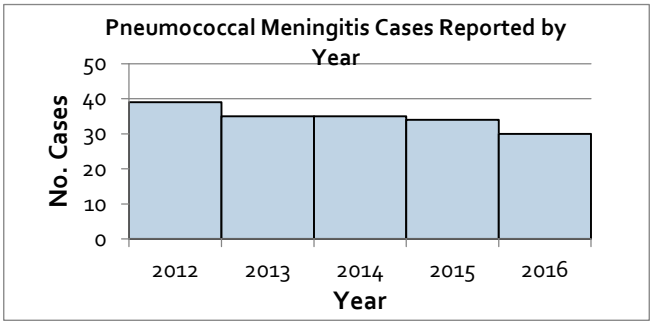
Outbreaks

No outbreaks of pneumococcal meningitis were reported in 2016.

Pneumococcal Meningitis, 2016

Annual Summary

	2012	2013	2014	2015	2016
Incidence / 100,000	0.40	0.36	0.35	0.34	0.30
No. cases	39	35	35	34	30
<5 yrs.	*13%*	*6%*	*9%*	*12%*	*20%*
≥ 5 yrs.	*85%*	*94%*	*91%*	*88%*	*80%*
Unvaccinated or unknown vaccination status (<5 yrs. only)	*20%*	*0%*	*67%*	*25%*	*0%*



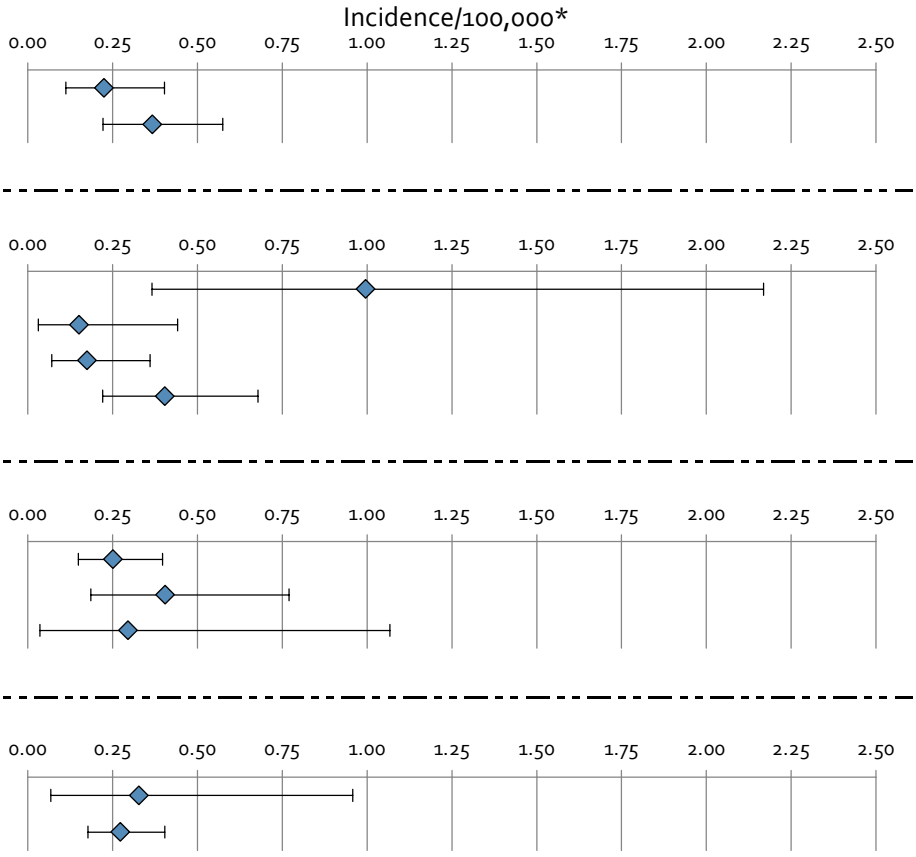
Case Demographics, 2016

Sex	*No. cases*	*% of total*	*Incidence/ 100,000*
Male	11	37%	0.22
Female	19	63%	0.37
Unknown	0	0%	--

Age Group	*No. cases*	*% of total*	*Incidence/ 100,000*
Under 5 yrs.	6	20%	1.00
5-19 yrs.	3	10%	0.15
20-49 yrs.	7	23%	0.17
50+ yrs.	14	47%	0.40
Unknown	0	0%	--

Race	*No. cases*	*% of total*	*Incidence/ 100,000*
White	18	60%	0.25
Black	9	30%	0.41
Other or multiple	2	7%	0.30
Unknown	1	3%	--

Hispanic Ethnicity	*No. cases*	*% of total*	*Incidence/ 100,000*
Yes	3	10%	0.33
No	25	83%	0.27
Unknown	2	7%	--



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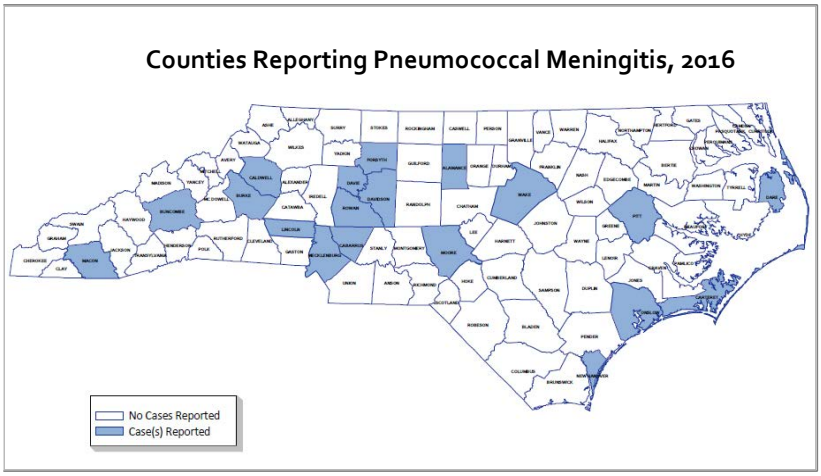
Geographic Distribution



Cases By Month