Nothing Compares
NORTH CAROLINA

# *Vaccine-Preventable Disease Update*

2017 North Carolina CD Conference

## *Disclosure*

Justin Albertson and Susan Sullivan have no financial conflicts of interest to disclose.

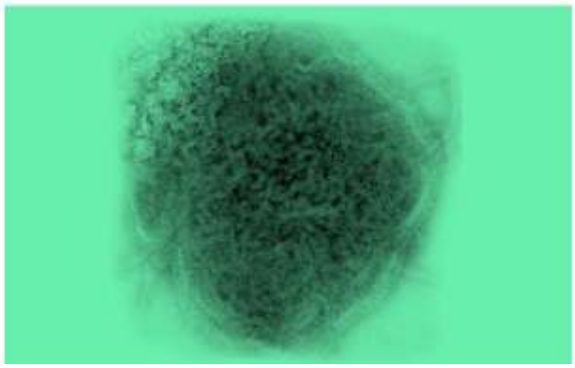
# *Objectives*

- Describe national and local mumps trends
- List public health goals of pertussis control
- Discuss the changing face of H. influenzae

## SWIMMING POOLS…

**Mumps outbreak at SUNY New Paltz: swim team quarantined, unvaccinated students sent home**

by Frances Marion Platt / October 31, 2016 / 17 comments



https://hudsonvalleyone.com/2016/11/07/suny-new-paltz-mumps-cases-rise-to-11-swim-meets-canceled-for-entire-semester/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NASCAR
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http://nhl.nbcsports.com/2017/02/26/canucks-gm-benning-says-mumps-outbreak-wont-impact-trade-deadline-plans/
CANUCKS GM BENNING SAYS MUMPS OUTBREAK WON'T IMPACT TRADE DEADLINE PLANS


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By CARTER EVANS / CBS NEWS / January 21, 2015, 9:02 PM

# Measles outbreak at Disneyland linked to non-vaccinations

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**VPDs MAKE HEADLINES!**

[illegible] may have been exposed to the measles at Disneyland and Disney California Adventure last month. Most of those who got the disease were not vaccinated against it.

With tens of thousands of visitors from around the world -- in close contact -- every day, the "Happiest Place on Earth" was an ideal place for the highly contagious disease to spread, according to epidemiolgist, Dr. Mark Zahn.

"You can be reasonably near someone, or breathe it in over time and you can become infected," said Zahn.

A measles outbreak is being blamed on a lack of vaccinations in Orange County, Calif. CBS NEWS

## *Impact of Vaccines in U.S.*

| Disease | 20th Century Annual Morbidity | 2014 Reported Cases | % Decrease |
|---|---|---|---|
| Smallpox | 29,005 | 0 | 100 |
| Diphtheria | 21,053 | 1 | >99 |
| Pertussis | 200,752 | 32,971 | 84 |
| Tetanus | 580 | 26 | 96 |
| Polio (paralytic) | 16,316 | 0 | 100 |
| Measles | 530,217 | 667 | >99 |
| Mumps | 162,344 | 1,223 | >99 |
| Rubella | 47,745 | 2 | >99 |

*Table adapted from Appendix E-7, CDC. Epidemiology and Prevention of Vaccine-Preventable Diseases.*

## *Cases of VPDs Reported in North Carolina, 2009–2015*

| Disease | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|
| Diphtheria | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Haemophilus influenzae* invasive disease | 115 | 92 | 102 | 140 | 140 | 169 | 180 |
| Hepatitis A | 45 | 29 | 38 | 42 | 43 | 38 | 52 |
| Measles | 1 | 1 | 0 | 22 | 1 | 0 | 1 |
| Meningococcal invasive disease | 13 | 16 | 8 | 9 | 10 | 5 | 5 |
| Mumps | 11 | 9 | 2 | 4 | 3 | 4 | 35 |
| Pertussis | 289 | 206 | 626 | 625 | 782 | 347 | 298 |
| Pneumococcal meningitis | 32 | 24 | 39 | 35 | 35 | 34 | 30 |
| Polio | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rubella | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Congenital rubella syndrome | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tetanus | 1 | 0 | 0 | 0 | 0 | 3 | 0 |

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| Disease | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|
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| Polio | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rubella | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Congenital rubella syndrome | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tetanus | 1 | 0 | 0 | 0 | 0 | 3 | 0 |

# *Mumps*

## King County teen wrestled in 16-state tourney, not knowing he had mumps

**Health officials in Washington and Minnesota so far are not reporting new cases linked to the tournament despite the close contact of the sport. His opponents, as well as fellow students at home, were alerted. The current outbreak has reached more than 5,300 cases nationwide.**

By Bob Young

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The national mumps outbreak could've been made worse by a Washington high school wrestler who competed in a 16-state tournament before he knew he was infected with the contagious disease.

But so far, health officials in Washington and Minnesota are not reporting new cases they believe are linked to the tournament.

The current national outbreak is the worst this century, except for 2006 when more than 6,500 cases were reported, according to the Centers for Disease Control and Prevention (CDC). By the end of 2016, the CDC tallied 5,321 cases nationwide.

That number might have soared after the Washington student, from King County, attended The Clash XV high school wrestling tournament in Rochester, Minn., on Dec. 30 and 31.

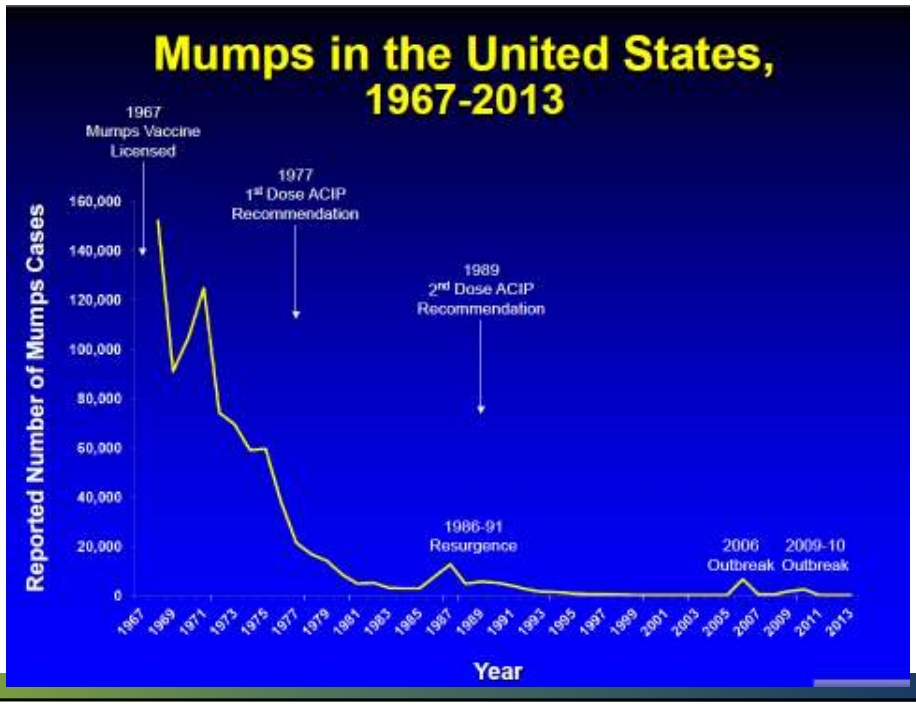
## Ongoing Spokane mumps outbreak prompts new vaccination clinic

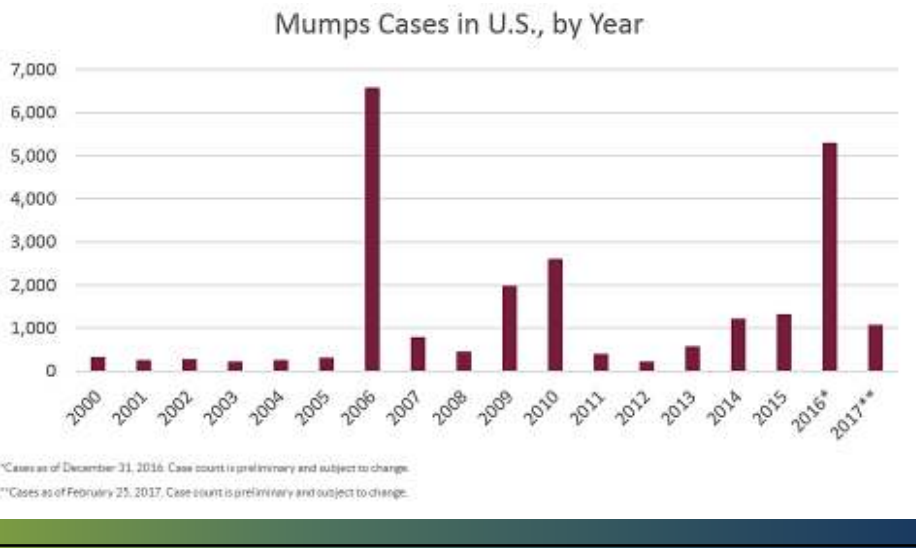
Partnerships

Tony Chavez, 3, gets a measles-mumps-rubella (MMR) vaccination from WSU College of Pharmacy student James Kent, right, and encouragement from his mother, Kelly Thomas, left, Jan 26, 2017, during the Homeless Connect event at the Salvation Army. UnitedHealthcare, in partnership with the Salvation Army, Walgreens and Spokane Regional Health District offered free shots for shots. Hundreds of people gathered to partake of the free services including hot meals, family services, veterans services food bank, haircuts and veterinary care for pets. Dan Pelle/THE SPOKESMAN-REVIEW (Dan Pelle / The Spokesman-Review)

# *Mumps*

- >150,000 cases/year prevaccine
- 1,000-2,000 cases/year average currently
- Outbreaks still occur in crowded settings
  - Schools
  - Colleges
  - Camps
  - Sports teams
- MMR vaccine limits size, duration, and spread of outbreaks


Mumps in the United States, 1967-2013
1967 Mumps Vaccine Licensed
1977 1st Dose ACIP Recommendation
1989 2nd Dose ACIP Recommendation
1986-91 Resurgence
2006 Outbreak
2009-10 Outbreak
Reported Number of Mumps Cases
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013
Year

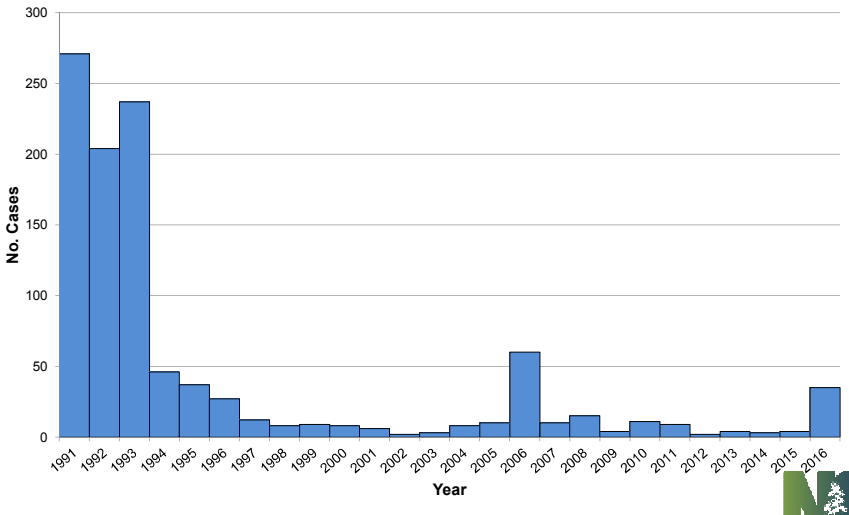

Mumps in the U.S.
Mumps Cases in U.S., by Year
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016* 2017**
*Cases as of December 31, 2016. Case count is preliminary and subject to change.
**Cases as of February 25, 2017. Case count is preliminary and subject to change.

# *Mumps in the U.S.*


*†AK, AZ, AR, CA, CO, CT, FL, GA, HI, ID, IL, IN, IA, KS, KY, ME, MA, MI, MS, MO, MT, NE, NV, NH, NJ, NY, NC, ND, OH, OK, OR, PA, TN, TX, VA, WA, and WI*

*††Preliminary data reported to CDC. Mumps outbreaks are not reportable.*

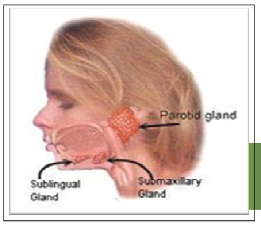
# *Mumps Cases Reported in North Carolina, 1991–2016*



# *Mumps Clinical Features*

- Prodrome
  - Myalgia
  - Malaise, anorexia
  - Low-grade fever
  - Headache
- Later manifestations
  - Up to 20% asymptomatic
  - Parotitis in 30-40%
  - 40-50% non-specific, respiratory
- Complications
  - Less frequent after vaccine
  - Orchitis (3–10% postpurbertal)
  - Mastitis, oophoritis, pancreatitis, deafness, meningitis, encephalitis all <1%

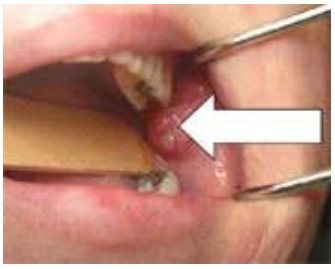
*Photo: CDC Public Health Image Library*




# *Mumps Diagnostics*

| Test | Specimen | Comments |
|---|---|---|
| PCR | Fluid-parotid duct swab, salivary gland, CSF, throat | SLPH: 1-3 days; Collect as soon as possible (within 3-8 days of parotitis/meningitis onset) Refer to SLPH Guide for details; Call Epi On Call for CD Branch approval |
| Mumps virus culture | Fluid-parotid duct swab, salivary gland, CSF, throat | SLPH: 3 weeks; Confirmed by IF, PCR Refer to SLPH Guide for details |
| IgM capture serology | Serology | Available at most commercial labs Unvaccinated: Collect after 3 days from onset Vaccinated: IgM response may be transient or absent |
| IgG serology | Acute/convalescent sera | SLPH: Paired sera- conversion from (-) to (+) Unvaccinated: rapid long lasting rise Vaccinated: elevated result in acute sera may prevent detection of 4 fold titer rise |

## *Proper Collection Technique*



Adapted from Illinois Dept. of Public Health – Div. of Laboratories (Chicago Virology Section)

Swab buccal cavity, which is the space near the upper rear molars between the cheek and the teeth.

1) Massage parotid area for 30 seconds.

2) Swab area between cheek and gum by sweeping the swab near the upper molar to lower molar area

## *Lab Testing Dos and Don'ts*

- **Do** call CD Branch Epidemiologist On Call for testing approval (919-733-3419)
- **Do** write the name of approver on lab slip
- **Do** interpret serology results from commercial labs with caution

- **Don't** rule out mumps based on negative lab results
- **Don't** forget to review other tests for a more likely diagnosis

# *Other Causes of Parotitis*

| Virus | Number positive (n) | Percent positive (n/101) |
|---|---|---|
| Epstein-Barr virus (EBV) | 23 | 23% |
| Human herpesvirus 6B (HHV-6B) | 10 | 10% |
| Human parainfluenza virus 2 (HPIV-2) | 3 | 3% |
| Human parainfluenza virus 3 (HPIV-3) | 1 | 1% |
| Human bocavirus (HBoV) | 1 | 1% |
| Mumps (MuV) | 0 | 0% |
| Enteroviruses (EV) | 0 | 0% |
| Human parechovirus (HPeV) | 0 | 0% |
| Human herpesvirus 6A (HHV-6A) | 0 | 0% |
| Human parainfluenza virus 1 (HPIV-1) | 0 | 0% |
| Adenoviruses (AdV) | 0 | 0% |
| **Total** | **38** | **38%** |

*Barskey et al. J Infect Dis, Sept. 19, 2013

# *Mumps Control Measures*

| Control Measure | Indication |
|---|---|
| MMR Vaccine | Not indicated for PEP<br>Vaccinate those without evidence of immunity |
| Immune globulin (IG) | Not indicated for PEP |
| Isolation | Case-patient: isolate/exclude for 5 days after parotitis onset<br>Healthcare setting: use droplet and standard precautions |
| Quarantine | Exposed non-immune contacts-<br>*Healthcare setting*: exclude from 12$^{th}$ day after 1$^{st}$ unprotected exposure through 25$^{th}$ day after last exposure<br>*School setting*: call CD Branch; exclude until 26$^{th}$ day after onset in last case; may be impractical in community outbreak setting |

*Pertussis*

# *Pertussis Transmission*

- Highly contagious respiratory infection
- Droplet and airborne transmission
- >80% household contacts infected*

*Mertsola et al, J Pediatr. 1983 Sep;103(3):359-63

## *Stages of Pertussis*

| Stage | Length | Clinical Features |
|---|---|---|
| Catarrhal | 1–2 weeks | Runny nose, mild cough |
| Paroxysmal | 1–6 weeks; up to 10 | Paroxysmal cough |
| Convalescent | 2–3 weeks; may be months | Less persistent cough; secondary infxn |

## *Images of Pertussis*

Source: www.immunize.org, courtesy of Thomas Schlenker, MD, MPH, Chief Medical Officer, Children's Hospital of Wisconsin and the Pennsylvania Chapter of the American Academy of Pediatrics

# *Infant Pertussis*

Source: ShotofPrevention.com. Brady passed away at 2 months from pertussis.

- Highest risk for complications
- Atypical symptoms
  - Catarrhal stage and cough minimal or absent
  - Whoop infrequent
  - Apnea (sometimes with seizures)
  - Sneezing
  - Gagging, choking, vomiting
- >50% require hospitalization
- 1% of hospitalized infants die

Adapted from http://www.cdc.gov/vaccines/ed/ciinc/Pertussis.htm

# *When to Suspect Pertussis*

- Duration of cough ≥ 2 weeks
- Paroxysmal cough, increasing cough duration and severity
- Afebrile

Cherry et al. Clin Infect Dis 2012;54:1756-64

## *Other Clues*

- Paroxysms more disturbing to the patient at night
- Cough not truly productive
- Coryza does not become purulent
- Sweating episodes between paroxysms

Cherry et al. Clin Infect Dis 2012;54:1756-64

## *When to Suspect Pertussis – Infants*

- May present with choking, gagging, or apnea with or without cyanosis
  - Cough may be subtle or absent
  - Fever minimal or absent
- Other clues:
  - Severe or prolonged cough in contacts
  - WBC ≥ 20,000 with >50% lymphocytes

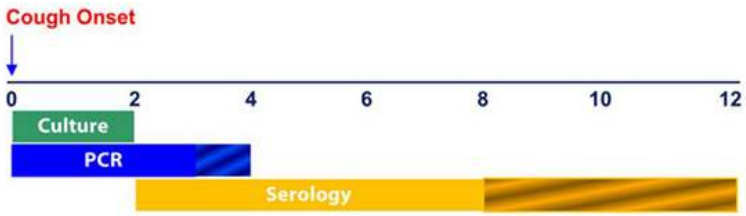
http://www.cdph.ca.gov/HealthInfo/discond/Documents/Cherry_Pertussis%20in%20Young%20Infants2_June%202011.pdf

## *Pertussis Tests*

| TEST | PROS | CONS |
|---|---|---|
| PCR | •Sensitive<br>•Fast | •False positives |
| Culture | •Specific<br>•Gold standard | •Slow<br>•Low sensitivity |
| Serology | •Detect late after onset | •Not standardized |
| DFA | •None (in 2012) | •Low sensitivity |

## *Pertussis Testing*

**Optimal Timing for Diagnostic Testing (weeks)**

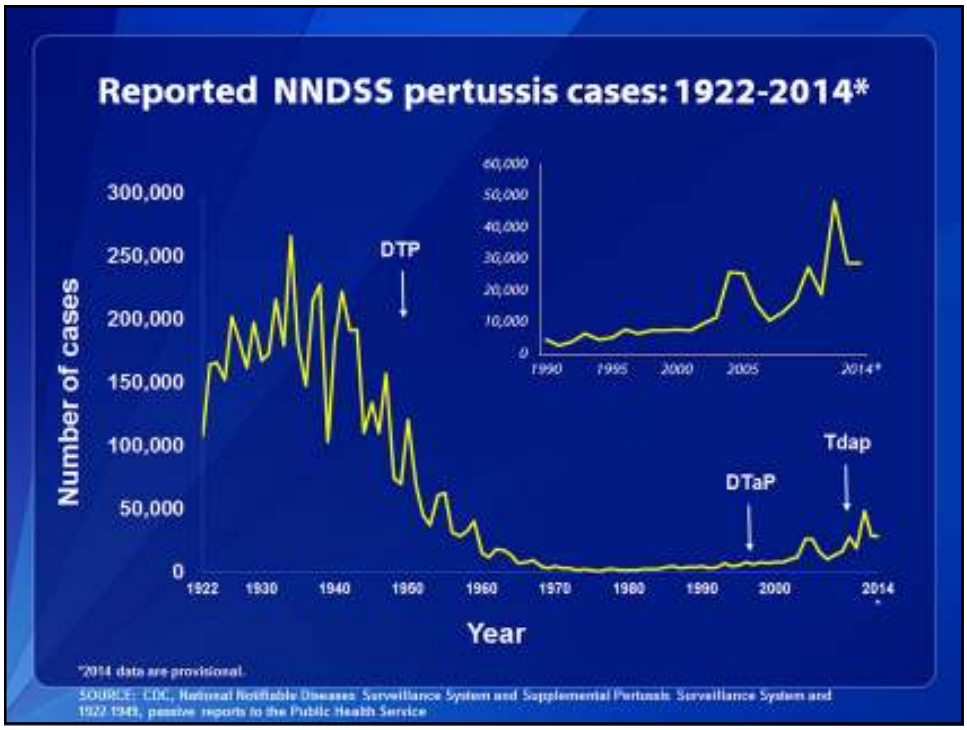



http://www.cdc.gov/pertussis/clinical/diagnostic-testing/diagnosis-confirmation.html

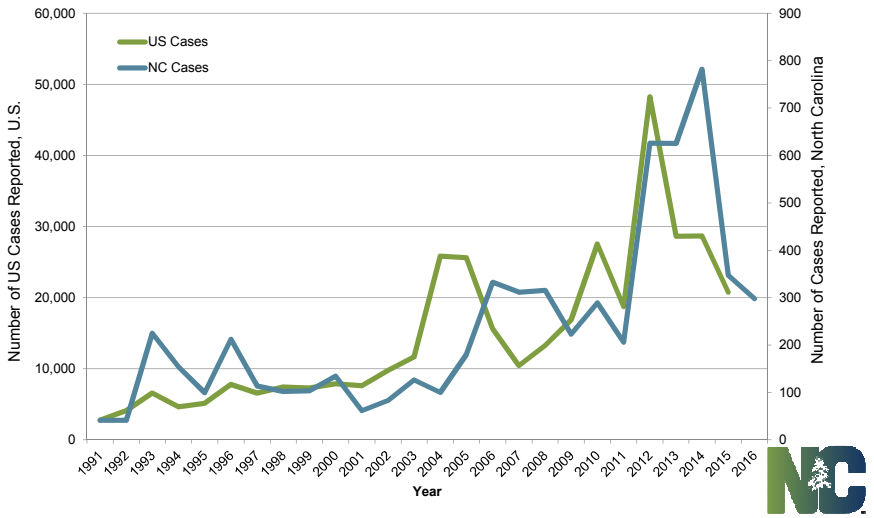
# *Pertussis Serologies*

- Not standardized
- Not recommended for routine clinical diagnosis
- Validated ELISA for anti-PT IgG available through state public health lab with approval

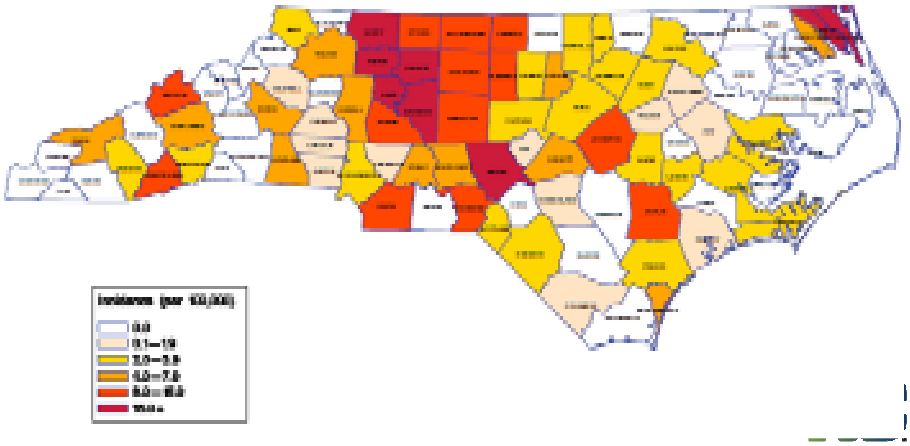
Menzies et al. Clin and Vaccine Immunol 2009; 16(12):1781–1788



## *Reported Pertussis Cases in US & NC, 1991–2016*




## *Pertussis Incidence by County: 2013*



## *Pertussis Incidence by County: 2014*

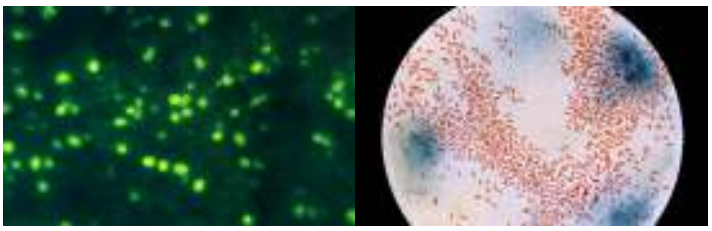

## *Pertussis Incidence by County: 2015*

## *Pertussis Incidence by County: 2016*


## *Haemophilus influenzae*

# *H. influenzae* etiology

- Not viral influenza
- *Gram-negative coccobacillus*
- Unencapsulated or encapsulated bacterium
  - Polysaccharide capsule allows isolates to be classified. Six serotypes (a, b, c, d, e, and f) with capsule
  - Strains without a capsule are called nontypeable. Nontypeable does **not** mean that serotyping could not be performed



https://www.cdc.gov/hi-disease/about/photos.html

# Clinical manifestations

**Encapsulated**

- Pneumonia
- Bacteremia
- Meningitis
- Epiglottitis
- Septic arthritis
- Cellulitis
- Otitis media
- Pericarditis, endocarditis, endophthalmitis, osteomyelitis, peritonitis, gangrene

**Nonencapsulated (nontypeable)**

- Respiratory tract infections
- Otitis media
- Sinusitis
- Pneumonia
- Conjunctivitis
- Bacteremia
- Meningitis
- Chorioamnionitis
- Neonatal sepsis

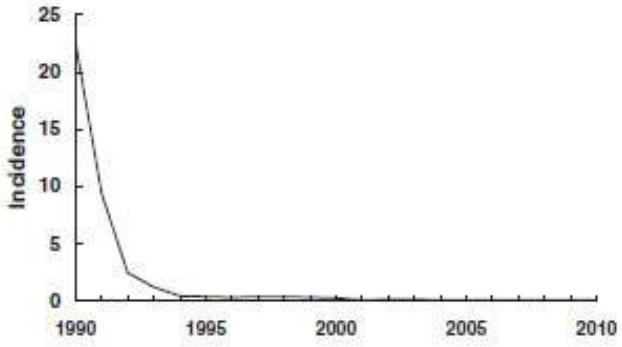
## *Haemophilus influenzae type b Epidemiology*

- Type b is most virulent serotype
- Reservoir
  - human - asymptomatic carriers
- Communicability is limited. Transmission occurs in neonates by:
  - aspiration of amniotic fluid
  - genital secretions during delivery
  - respiratory droplets

Temporal pattern - peaks in Sept-Dec, March-May

https://www.cdc.gov/vaccines/pubs/pinkbook/hib.html

## *Incidence* of Invasive Hib Disease, 1990-2010*




*rate per 100,000 children <5 years of age

https://www.cdc.gov/vaccines/pubs/pinkbook/hib.html

## *Polysaccharide-protein conjugate vaccines*

- Available for young children
- Significantly decreased burden of Hib meningitis
- Induced herd immunity- rarely a public health problem now
- Other serotypes and nontypeable strains are now predominant

## *Public health response*

- All isolates from normally sterile site must be sent to state lab for typing-10A NCAC 41A .0209
- For Hib cases, PEP is only recommended for households with under-immunized child <4 or immunocompromised child in home
- PEP not recommended for contacts to non-type b since secondary disease is rare
- Refer to current Red Book for chemoprophylaxis guidance (Table 3.9)

American Academy of Pediatrics. 2015 Red Book. 30th ed.

## *Normally Sterile Sites*

- blood
- bone and bone marrow
- cerebrospinal fluid (CSF)
- internal body sites - specimen obtained from surgery or aspirate from : brain, heart, kidney, liver, lymph node, ovary, pancreas, spleen, vascular tissue, vitreous fluid
- joint fluid – (synovial fluid, needle aspirate, or culture of any specific joint: ankle, elbow, hip, knee, wrist)
- muscle
- pericardial fluid
- peritoneal fluid - includes abdominal fluid, ascites
- pleural fluid - includes chest fluid, thoracentesis fluid

http://www.health.state.mn.us/divs/idepc/dtopics/invbacterial/sterile.html

## *Purpose of Reporting and Surveillance*

1. To identify preschool-age children who may have been significantly exposed to *Haemophilus influenzae* type b (Hib) cases

2. To monitor exposed children for signs of illness

3. To recommend antibiotic prophylaxis and/or immunization to appropriate contacts of Hib cases

4. To identify additional cases and establish risk factors for non-Hib cases

## *H. Influenzae Reporting Tips*

✓A positive blood culture indicates bacteremia so check that box in NC EDSS Clinical Package!

✓Positive blood culture = confirmed case

✓Information about co-morbidity, immunosuppression, severity of illness helps characterize risk factors in adults

✓Clinical outcome matters!

## *National 2009-2014 data: resistance*

- Resistance to beta-lactam antimicrobials is common in *H. influenzae* isolates
- Alternatives: amoxicillin-clavulanate, oral cephalosporin, or azithromycin
- Susceptibility testing helps guide therapy

CDC (2016 CSTE conference)
American Academy of Pediatrics. 2015 Red Book. 30th ed.
http://www.cdc.gov/meningitis/lab-manual/chpt02-epi.html

# *National 2009-2014 data: serotypes*

- Only 1.7% of invasive *H. influenzae* disease was due to Hib
- Serotype f was majority (63%) of non-b encapsulated serotypes; 20% due to serotype a, 17% serotype e, and 0.3% serotype d

CDC (2016 CSTE conference)

# *NC Invasive H. influenzae, Incidence by Year, 2011-2016*

| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| **Incidence / 100,000** | 0.95 | 1.04 | 1.42 | 1.43 | 1.70 | 1.80 |
| **No. cases** | 92 | 102 | 140 | 141 | 169 | 180 |

NC EDSS data, 2011-2016

## *NC H. influenzae types for 2013-2015*

| TYPE | TOTAL | % |
|---|---|---|
| Unknown | 43 | 9.7% |
| Typed, b | 4 | 0.9% |
| Typed, non b | 100 | 22.6% |
| Non-typeable | 296 | 66.8% |
| TOTAL | 443 | 100% |

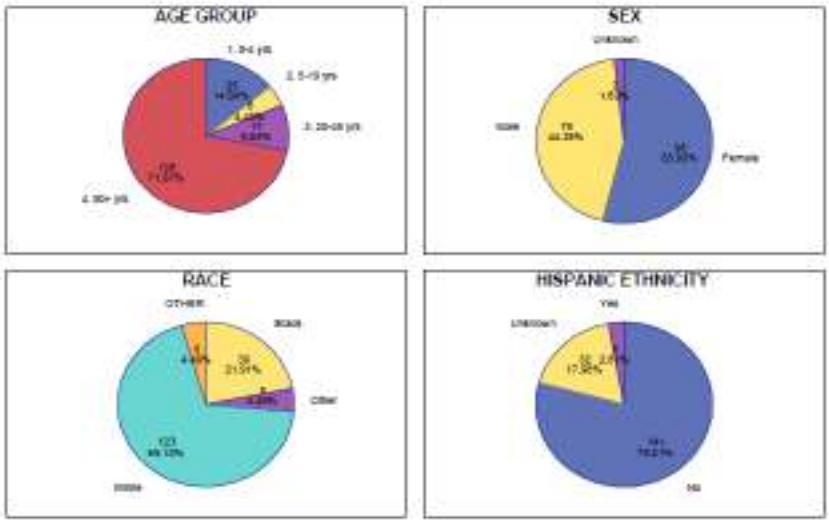
NC EDSS data, 2016
CDC (2016 CSTE conference)

## *NC H. influenzae Non b, typed for 2013-2015*

| TYPE | TOTAL | % of TYPED |
|---|---|---|
| A | 13 | 13% |
| C | 0 | 0% |
| D | 0 | 0% |
| E | 19 | 19% |
| F | 68 | 68% |
| TOTAL | 100 | 100% |

CDC (2016 CSTE conference)

## *Reported NC Invasive H. influenzae Cases by Age, Sex, Race, Ethnicity, 2016*




## *Reported NC Invasive H. influenzae Incidence by Age, 2016*

| Age Group | Cases | % of Total | 2015 Population | Incidence Per 100,000 |
|---|---|---|---|---|
| **0 – 4 yrs** | 25 | 14.0 | 602,152 | 4.15 |
| **5 - 19 yrs** | 8 | 4.5 | 1,983,747 | 0.40 |
| **20 – 49 yrs** | 18 | 9.6 | 4,006,427 | 0.45 |
| **50+ yrs** | 129 | 71.9 | 3,464,357 | 3.72 |
| | **180** | **100.0** | **10,056,683** | |

# *Reported NC Invasive H. influenzae Case Deaths, 2016*

| Age Group | Deaths | Percentage | Incidence Per 100,000 |
|---|---|---|---|
| 0 - 4 | 3 | 13 % | 0.05 |
| 5 - 19 | 0 | 0 % | 0.00 |
| 20 - 49 | 1 | 4 % | 0.02 |
| 50+ | 19 | 83 % | 0.55 |
| Total | 23 | 100 % | |

N = 31; missing data = 8

# *Invasive H. influenzae in adults*

- Incidence appears to be increasing in adults
- Caused mostly by non-typeable and f
- Age and coexisting factors (COPD, CAD, CHF, smoking) are likely predisposing factors
- Patients ≥65 years of age with invasive H. influenzae disease (Hib, non-b, and nontypeable) have higher case-fatality ratios than children and young adults

# *References*

Jessica R. MacNeil, Amanda C. Cohn, Epidemiology of Invasive *Haemophilus influenzae*, CID 2011:53 (15 December) http://cid.oxfordjournals.org/

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