Introduction to Communicable Disease Surveillance and Investigation in North Carolina

January 2014

Vaccine-Preventable Diseases 1

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Vaccine-Preventable Diseases 1

Session 1

- Introduction to vaccine-preventable diseases (VPDs)
- Pertussis
  - Clinical and epidemiological features
  - Vaccine benefits and limitations
  - Local health department investigations

Session 2

- Other VPDs
  - Varicella
  - Measles, mumps, rubella
  - Diphtheria, tetanus, polio
- Reporting VPDs in NC EDSS

Learning Objectives

1. Recognize public health significance of vaccine-preventable diseases (VPDs)
2. Describe the epidemiology of pertussis and its changing trends
3. Describe the basic steps in a pertussis case investigation

VACCINE-PREVENTABLE DISEASES SESSION 1

Presented by: Kristin M. Sullivan, MPH

Vaccine-Preventable Diseases

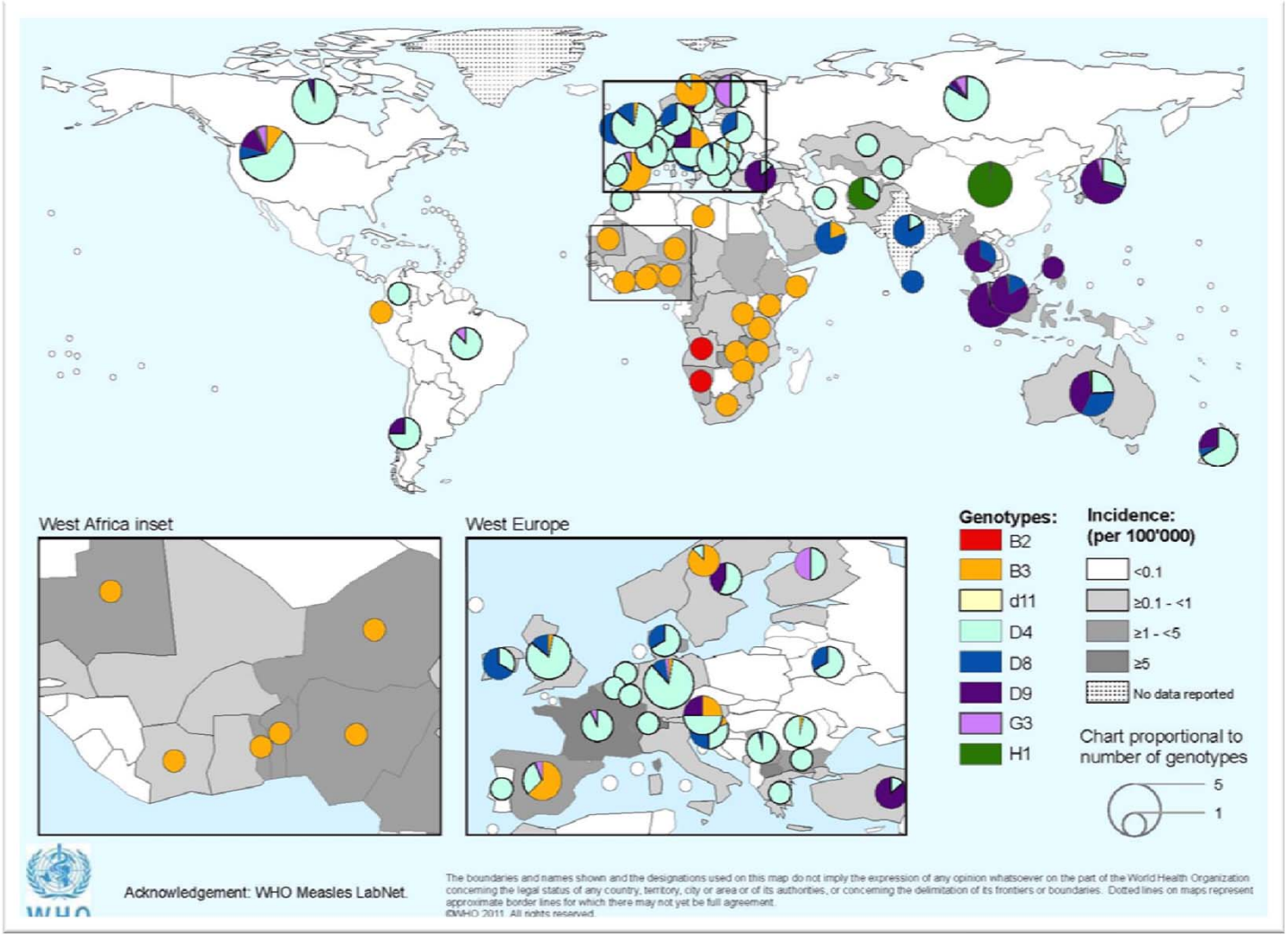
- Anthrax
- Diphtheria
- Hepatitis A
- Hepatitis B
- *Haemophilus influenzae* type b
- Human Papillomavirus
- Influenza
- Japanese encephalitis
- Lyme Disease (not in US)
- Measles
- Meningococcal
- Monkeypox (smallpox vaccine)
- Mumps
- Pertussis
- Pneumococcal
- Polio
- Rabies
- Rotavirus
- Rubella
- Shingles (Herpes Zoster)
- Smallpox
- Tetanus
- Tuberculosis
- Typhoid
- Varicella (Chickenpox)
- Yellow Fever

Impact of Vaccines

Disease	20th Century Annual Morbidity	2011 Reported Cases	% Decrease
Smallpox	29,005	0	100
Diphtheria	21,053	0	100
Pertussis	200,752	18,719	91
Tetanus	580	36	94
Polio (paralytic)	16,316	0	100
Measles	530,217	220	>99
Mumps	162,344	404	>99
Rubella	47,745	4	>99
Congenital Rubella Syndrome	152	0	100

Table adapted from page G-7, CDC. Epidemiology and Prevention of Vaccine-Preventable Diseases. Atkinson W, Wolfe S, Hamborsky J, eds. 12th ed., second printing. Washington DC: Public Health Foundation, 2012.
2011 Cases: MMWR. Summary of Notifiable Diseases — United States, 2011, July 5, 2013 / 60(53);1-117

Distribution of Measles Genotypes, 2011



VPDs Around the Globe

http://wwwnc.cdc.gov/travel/notices (Accessed 10/1/13)

Estimated Vaccination Coverage -- National Immunization Survey, United States, 2012

Children Aged 19–35 months			
	≥1 MMR	≥4 DTaP	Combined series*
North Carolina	89.0	85.9	75.4

* Includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 doses of measles vaccine, full series of Hib (3 or 4 doses, depending on product), ≥3 doses of HepB, ≥1 doses of varicella vaccine, and ≥4 doses of PCV.

Adolescents Aged 13-17 Years			
	≥2 MMR	≥ 1 Tdap	Hx. disease or ≥ 2 varicella vaccine
North Carolina	93.2	87.9	79.1

http://www.cdc.gov/vaccines/stats-surv/nis/default.htm

Importance of VPD Surveillance

- Document and monitor impact of vaccination program on disease incidence, morbidity and mortality
- Evaluate the effectiveness of prevention strategies
- Evaluate vaccine effectiveness under conditions of routine use
- Guide vaccination policies
- Inform future vaccine development

VPD Case Investigations

In vaccinated individuals, consider:

- Vaccine characteristics
  - What is the vaccine effectiveness?
  - Does immunity wane?
- Lab results
  - Are they interpretable?
  - Can they be used to rule in/out disease?
- Clinical picture
  - Do we expect a non-classic or modified presentation?

Suspected Cases: Questions to Ask

Clinical

- Signs & Symptoms?
  - Order of appearance
  - Type
  - Duration
- Testing performed?
  - Type
  - Results
- More likely *clinical* explanation for illness?

✓ *Has the case definition been met?*

Epidemiological

Immune status?

- Recent travel?
- Contact with traveler?
- Contacts with similar symptoms?
- More likely *epidemiological* explanation for illness?

✓ *Vaccine History*
✓ *Birth Year*
✓ *Serological Testing for Immunity*
✓ *Previous History of Disease*

Summary

- VPDs are still a threat to public health
- High immunization rates are crucial
- Knowing vaccination status is important for:
  - Monitoring vaccine effectiveness
  - Interpreting clinical and laboratory findings

Pertussis (Whooping Cough)

Impact of Vaccines

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Pertussis

- Highly contagious respiratory infection
- Spread by coughing or sneezing
- >80% susceptible household contacts infected

Image: CDC

Bordetella pertussis

- Bacteria that cause pertussis
- Attach to the cilia in upper respiratory tract
- Release toxins, damage cilia and cause inflammation

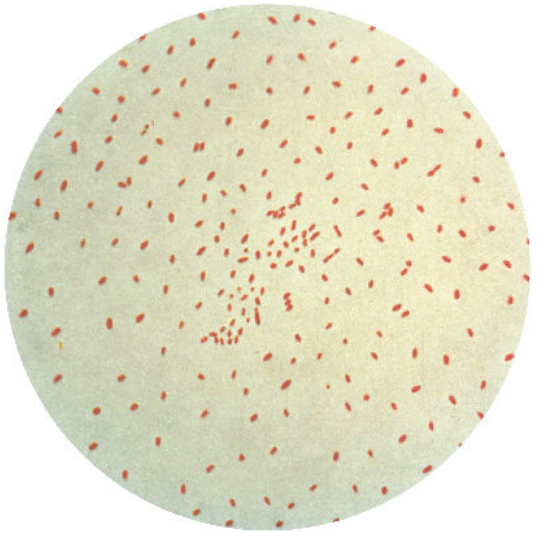


Image: CDC

Pertussis: Epidemiology

- Mode of transmission: droplet
- Incubation period: 7 – 10 day (range 4 – 21 days)
- Infectious period: start symptoms – 3 weeks of cough or 5 days after treatment

Common Pertussis Terms

Term	Definition
Paroxysmal cough	Sudden uncontrollable “fits” or spells of coughing where one cough follows the next without a break for breath
Whoop	High-pitched noise heard when breathing in after a coughing spasm
Apnea	Transient cessation of respiration which might occur spontaneously or after a coughing spasm
Posttussive vomiting	Vomiting following paroxysms of cough

Manual for the Surveillance of Vaccine-Preventable Diseases, Chapter 10: Pertussis (Jul 2011)

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	Weeks to months	Less persistent cough; secondary infection

Complications

- Infants at highest risk of complications
  - 2004 – 2008: 111 infant deaths
  - 83% in infants < 3 months old
  - >50% require hospitalization
  - 1% of hospitalized infants die
- Secondary bacterial pneumonia
  - Most common complication

Infant with Pertussis

Courtesy of the California Department of Health Services and Dr. James Cherry, UCLA from www.immunize.org

Pertussis in Infants

- Atypical symptoms
  - Catarrhal stage and cough minimal or absent
  - Whoop infrequent
  - Apnea (sometimes with seizures)
  - Sneezing
  - Gagging, choking, vomiting

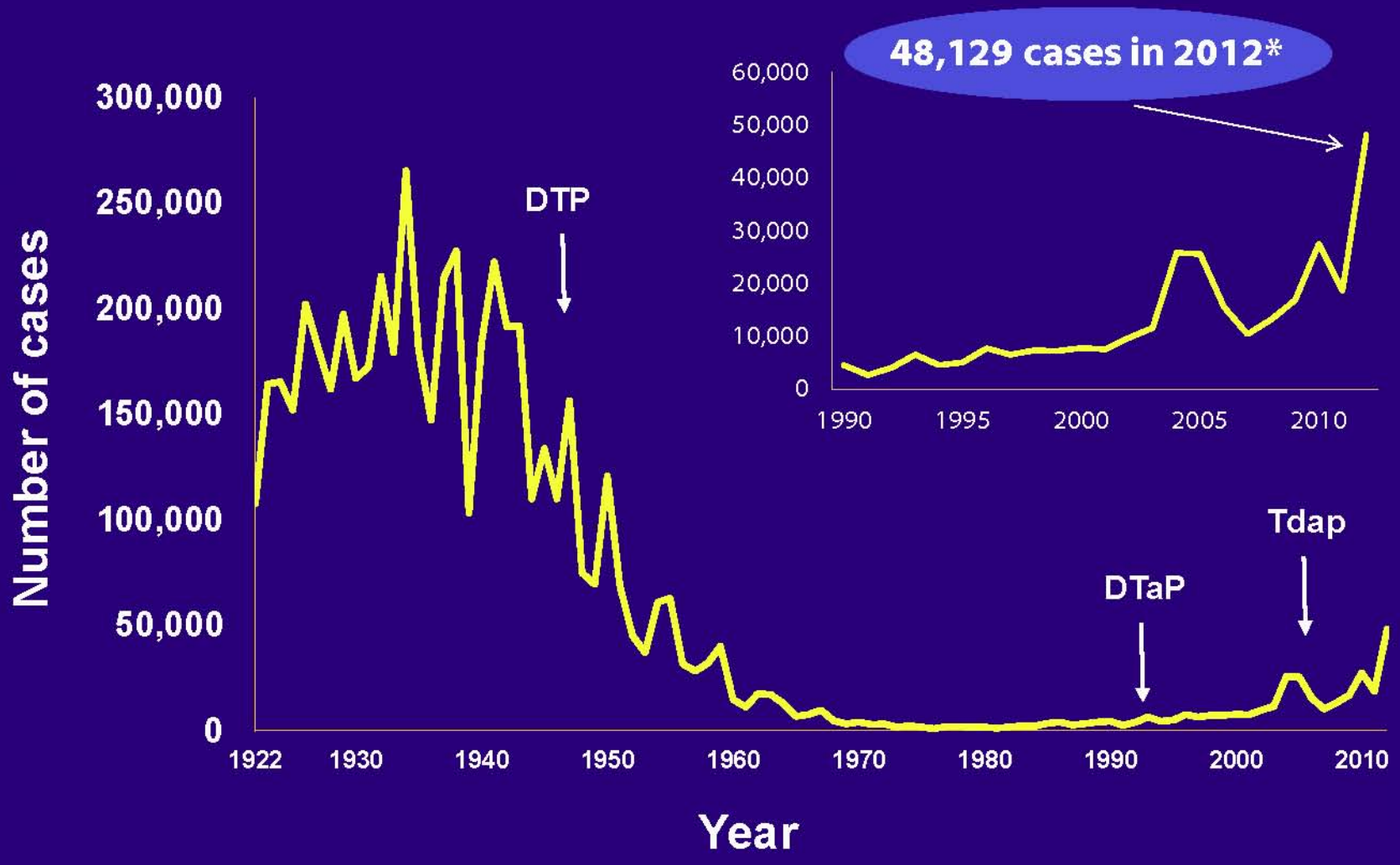
Image: CDC

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

Pertussis in Vaccinated Individuals

- May be milder than in infants and young children
- Wide spectrum of presentation
  - Asymptomatic infections can occur
  - Mild cough
  - Severe illness and classic presentation
- Whoop uncommon
- Can still transmit disease and are often source to infants

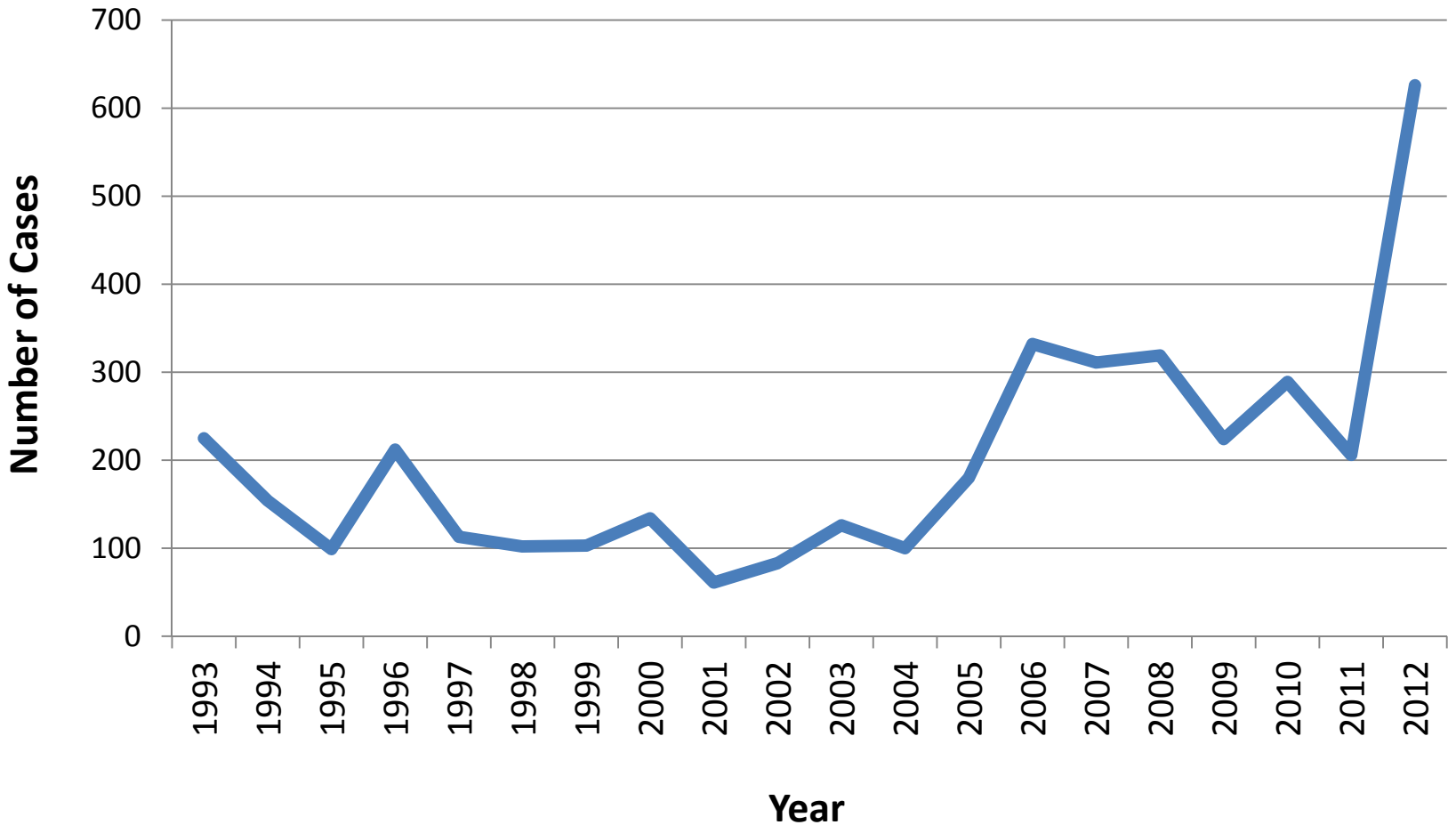
Reported Pertussis Cases: 1922-2012*



*2012 data are provisional and subject to change

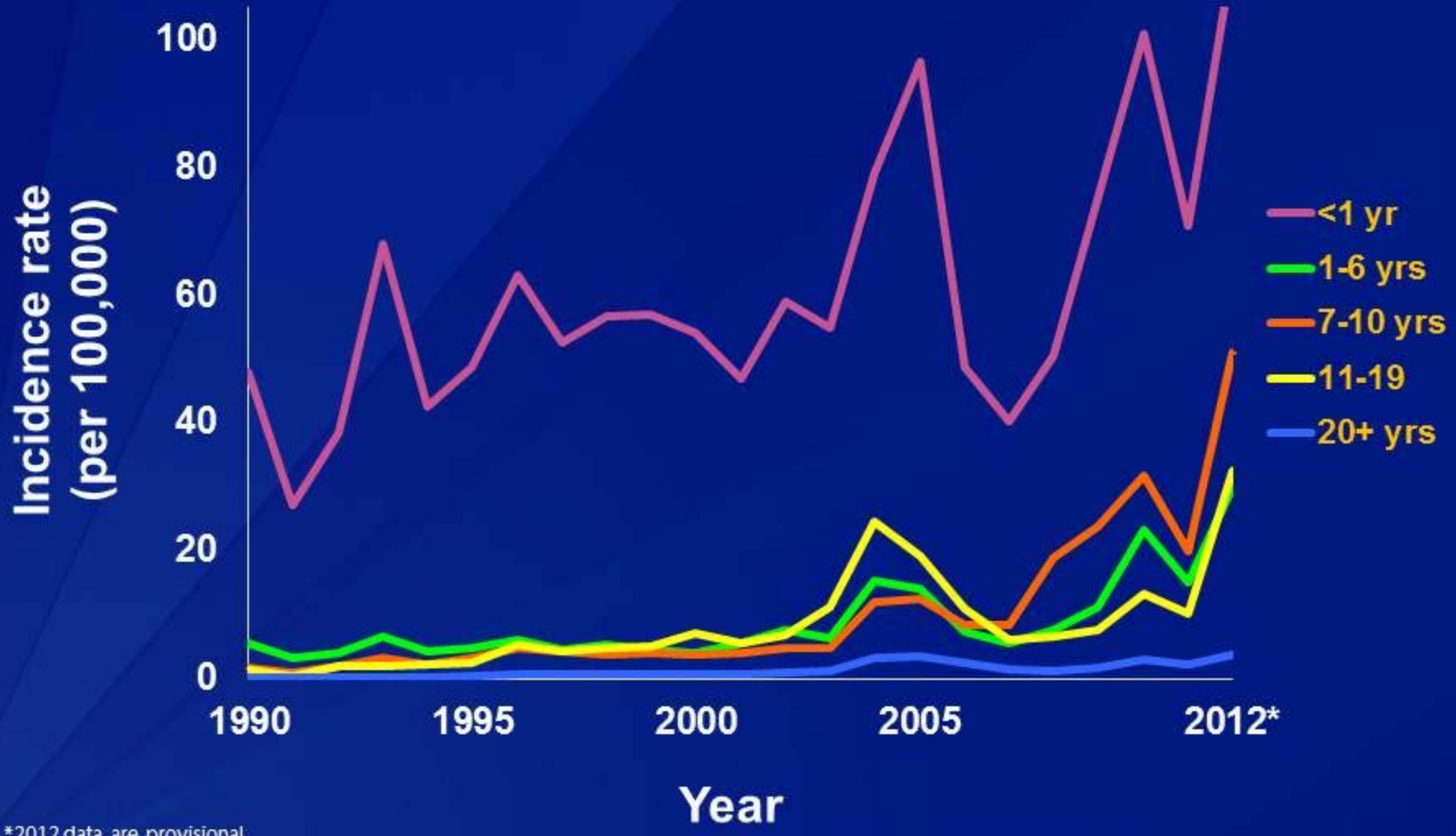
SOURCE: CDC, National Notifiable Diseases Surveillance System , Supplemental Pertussis Surveillance System, and passive reports to the Public Health Service (1922-1949)

Pertussis Cases Reported in North Carolina, 1993-2012*



*Data are preliminary and subject to change

Reported pertussis incidence by age group: 1990-2012*



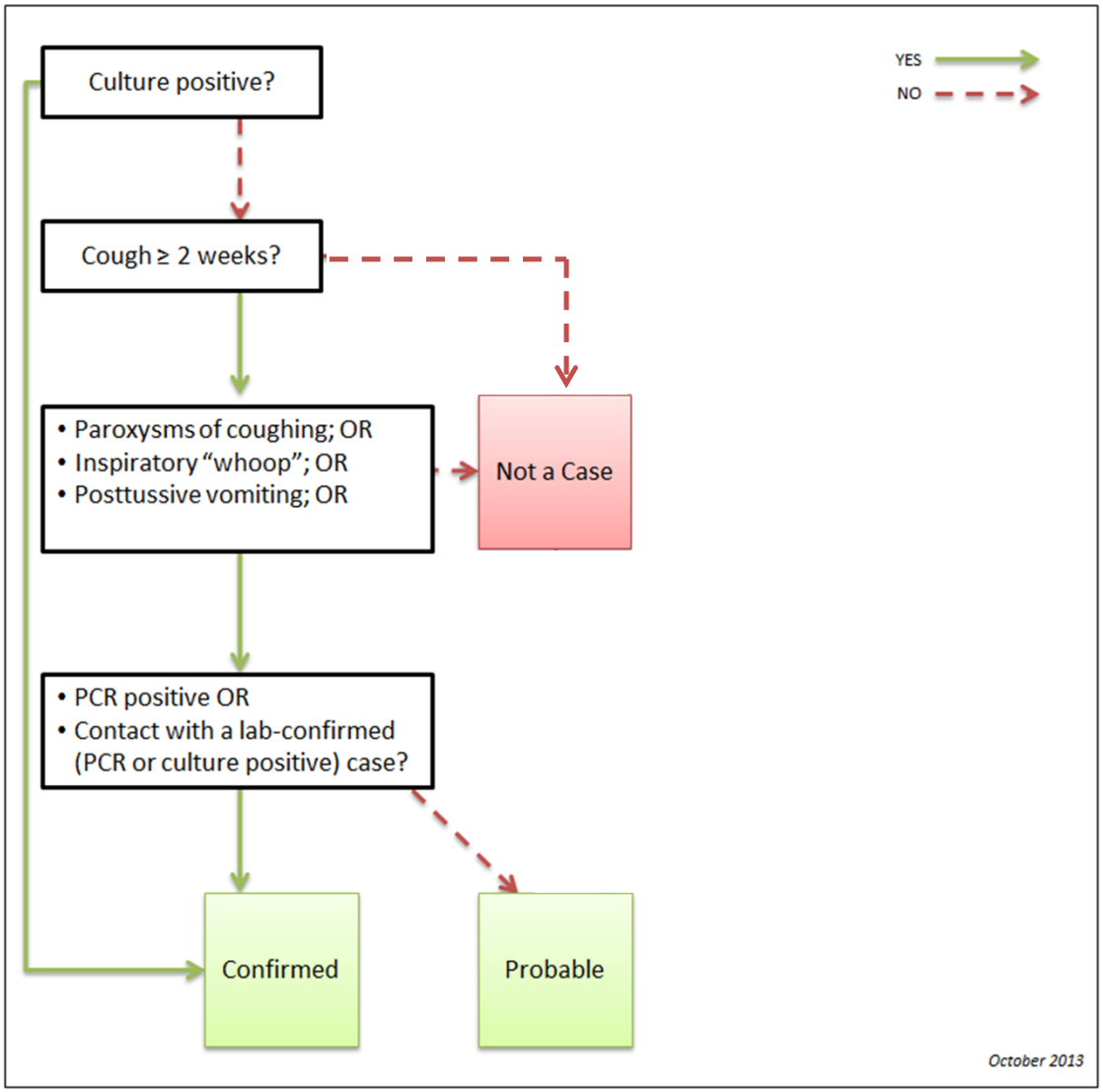
*2012 data are provisional.

SOURCE: CDC, National Notifiable Diseases Surveillance System and Supplemental Pertussis Surveillance System

Pre-2014 Case Definition

Prolonged cough →

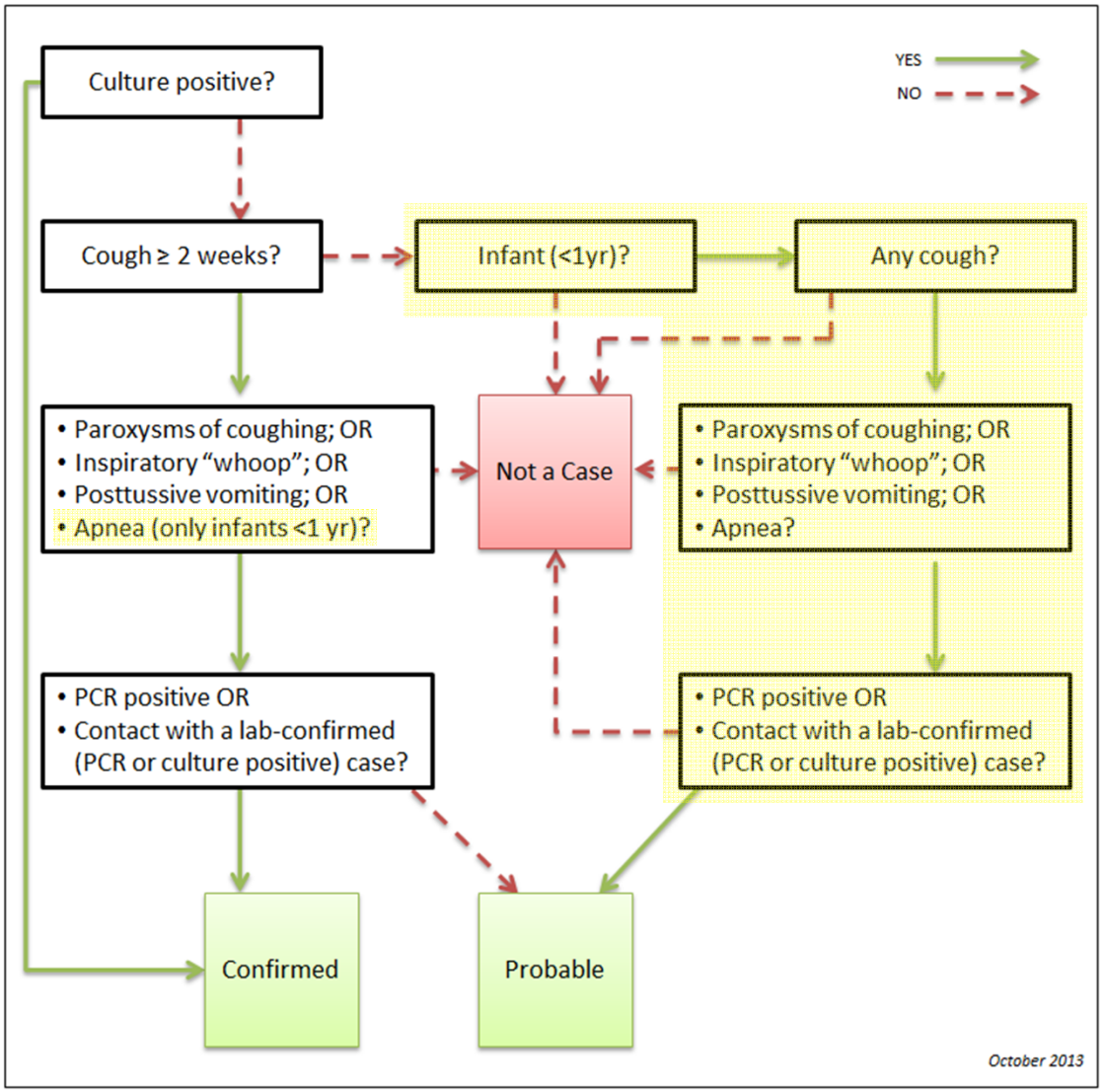
One accessory symptom →



2014 Case Definition

Prolonged cough →

One accessory symptom →



Reasons for Increase

- ✔ Better diagnostic testing (PCR)
- ✔ Increased recognition and reporting
- ? Natural 3–5 year cycles
- ? New strains
- ✔ Waning immunity from DTaP/Tdap

Pertussis Vaccines

- DTP (1940s)
- DTaP (1990s)
  - Infants at 2, 4, 6 months (1997)
  - Toddlers at 15-18 months (1992)
  - Pre-school at 4-6 years (1992)
- Tdap (2005)
  - Children 7–10 who are not fully immunized against pertussis
  - Adolescents 11–18 (preferably at age 11–12)
  - Adults ≥19, especially if in close contact with infants

DTaP: Effectiveness and Duration

- DTaP efficacy 80%–85%*
  - Highly effective, but can't rule out infection based on vaccination status
- Protection fades over time
  - General estimate 4–12 years
  - Recent studies suggest shorter duration with DTaP

**Following 3 doses*

Tdap: Effectiveness and Duration

- Effectiveness ~70% in field observational studies
- Preliminary data suggest effectiveness wanes within 3–4 years among acellular recipients

http://www.cdc.gov/vaccines/acip/meetings/downloads/slides-feb-2013/03-Pertussis-Clark.pdf

Waning Immunity

- DTaP and Tdap protection wanes within 5 years
- Likely contributor to increasing incidence, especially among children 7–10
- Vaccine still remains best way to prevent pertussis
  - Decreased severity, duration, and infectivity with breakthrough cases

PERTUSSIS CASE INVESTIGATIONS

Laboratory Criteria for Diagnosis

- Positive *B. pertussis* culture or
- Positive polymerase chain reaction (PCR)
- Serological testing performed *with a CDC-validated test*
  - CDC
  - VPD Reference Labs
  - Few state public health labs

Pertussis Labs: No Perfect Test

Clinicians Want:

- High sensitivity (few missed cases)
- Rapid results

Health Departments Want:

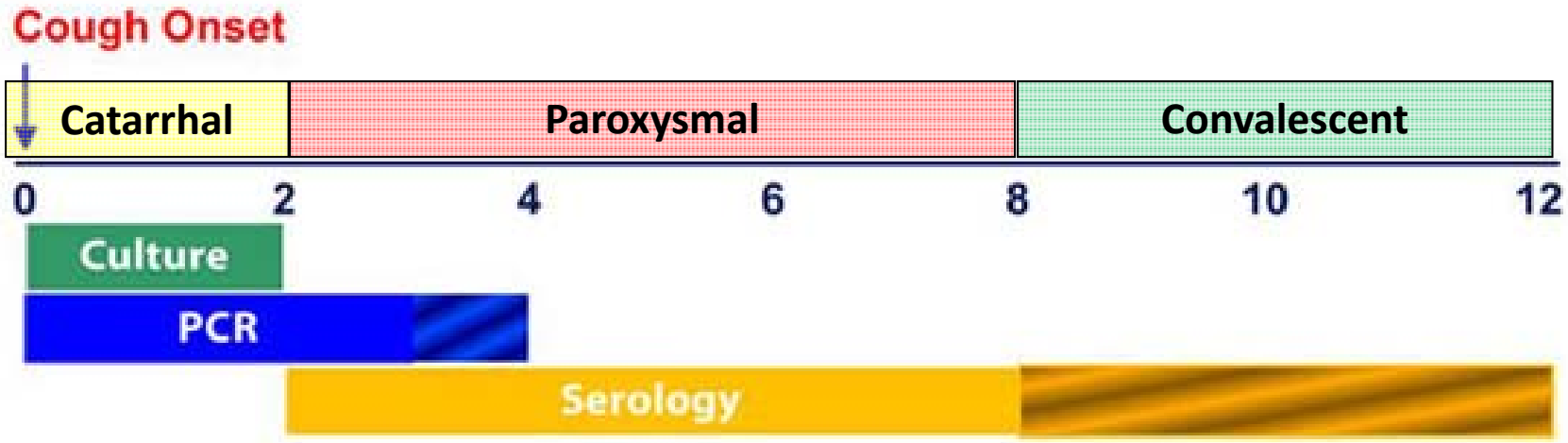
- High specificity (few false positives)
- Confirm etiology
- Avoid “pseudo-outbreaks”

APHL: Current Methods for the Diagnosis of Pertussis Infections, Jan 21, 2010

Pertussis Labs: No Perfect Test

Test	Pros	Cons
PCR	•Sensitive •Fast	•Vary in specificity •False positives
Culture	•Specific (100%) •Gold standard	•Slow •Low sensitivity
Serology	•Useful late in illness	•Commercial results not useful
DFA	•*None*	•*Low sensitivity*

Optimal Timing for Diagnostic Testing



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

PCR Precautions

- False negatives
  - Testing too late in illness
  - Improper specimen collection
- False positives
  - Testing patients without signs/symptoms
  - Contamination of swab with vaccine DNA
    - *Best Practices for Health Care Professionals on the use of PCR for Diagnosing Pertussis* (CDC Website)

Pertussis Labs: Key Points

- There is no perfect test
  - Diagnosis based on clinical history and lab results
- PCR should be used *in addition* to culture
  - Avoid “pseudo-outbreaks”
  - Appropriate PCR testing
- Limited role for serologies

Treatment

- Macrolides
  - Azithromycin
  - Clarithromycin
  - Erythromycin
- May modify course if given early
- Not recommended after 3 weeks of cough
- Consider for up to 6 weeks for:
  - Infants
  - Pregnant women

Case Investigation

- Ensure proper testing has been performed and treatment has been initiated
- Instruct cases to refrain from public activities and school/work until no longer infectious
  - Earliest of either:
    - 5 days after appropriate treatment or
    - 21 days after cough onset

Contact Investigation

- Identify contacts who have:
  - Had direct face-to-face contact
  - Shared the same confined space in close proximity for ≥ 1 hour
  - Had direct contact with respiratory, oral or nasal secretion
- In high-risk settings, determination of contacts should be more inclusive

School Contacts

- Students (including, but not limited to):
  - Core group of close friends, social contacts, boyfriends
  - Students sitting next to the case in class, extra-curricular activities, field trips
  - Students who work closely together
  - Bus seatmates or carpool contacts
  - Same after school programs and sports
- Consider staff, aides, volunteers

Symptomatic Contacts

- Refer for evaluation
  - Testing
  - Treatment
- Instruct symptomatic contacts to refrain from public activities and school/work until no longer infectious or until pertussis has been ruled out

Post-Exposure Prophylaxis (PEP)

- Primary objective: Prevent death and serious complications in individuals at increased risk of severe disease

High-risk Groups

Infants	Women in 3rd trimester of pregnancy	Individual with pre-existing health conditions
		

Images: CDC

PEP Recommendations

- All household contacts
- Contacts at high-risk or who will have close contact with someone at high-risk
  - Close contacts at high risk for severe illness
  - Close contacts who are themselves in close contact with a someone else at high risk for severe illness
  - *All* contacts in high risk settings that include infants aged <12 months or women in the third trimester of pregnancy

Vaccination status DOES NOT influence recommendations for PEP

http://www.cdc.gov/pertussis/outbreaks/PEP.html

Broader Use of PEP

- Consider in situations with
  - Small number of cases
  - Limited closed settings
  - No ongoing, community-wide outbreak
- Consultation with health department

Other Public Health Responses

- Vaccination
  - Ensure contacts are up-to-date on vaccination
  - Especially:
    - Adults in close contacts with infants
    - Healthcare workers
- Surveillance
  - Instruct asymptomatic contacts to monitor for symptoms
  - Conduct active surveillance for at least 42 days after cough onset of last case

Lab Results Unavailable

- Strong suspicion of pertussis
  - Identify and provide prophylaxis to close contacts
- Low suspicion of pertussis
  - Can delay identification until there is laboratory confirmation
  - Do NOT delay prophylaxis of infants and their household contacts

Summary

- Pertussis incidence is increasing
  - Likely related to shorter duration of immunity since switch to acellular vaccines
- Vaccination is still the best tool for prevention
- Public health response is to prevent death and serious complications in individuals at increased risk of severe disease

Resources

Reference	Edition / Date	Website
Manual for the Surveillance of Vaccine-Preventable Diseases, Chapter 10: Pertussis (Nov. 2013)	5th Edition, 2011	http://www.cdc.gov/vaccines/pubs/surv-manual/index.html
Epidemiology and Prevention of Vaccine-Preventable Diseases	12th Edition Second Printing (May 2012)	http://www.cdc.gov/vaccines/pubs/pinkbook/index.html
CDC Pertussis Website	Accessed Oct. 2013	http://www.cdc.gov/pertussis/