Pertussis Trends and Prevention

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Objectives

- Review clinical presentation of pertussis
- Describe impact of DTaP and Tdap vaccines
- Describe trends of pertussis rates in the US and WV
- Describe theories for recent increases in pertussis rates
- Identify strategies for preventing pertussis among infants, children and adults

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The Organism

- Caused by a gram-negative bacteria, *Bordetella pertussis*
- *B. pertussis* produces biologically active products (e.g. toxins) responsible for disease signs and symptoms, and immunity to infection.
- Infection and vaccination – does not provide lifelong immunity

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Pertussis (Whooping Cough)

- A **human disease**, no animal or insect source or vector is known to exist
- Highly contagious - transmitted **person-to-person** by direct or droplet contact with nasopharyngeal secretions of an infected person.
- **Incubation period**: 7-10 days, range: 5-21 days

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Pertussis (Whooping Cough)

- **Infectious Period**
  - Untreated: from early catarrhal stage through the first 2 – 3 weeks after cough onset
  - Treated: non-infectious after the 5th day of antibiotics

Pertussis Timeline

Disease Progression: Pertussis

Weeks

0 1 2 3 4 5 6 7 8 9 10 11 12

Stage 1
Catarrhal Stage
May last 1 to 2 weeks

– Symptoms: runny nose, low-grade fever, mild, occasional cough – Highly contagious

Stage 2 - Paroxysmal Stage

Lasts from 1-6 weeks; may extend to 10 weeks

Symptoms: fits of numerous, rapid coughs followed by "whoop" sound; vomiting and exhaustion after coughing fits (called par-oxymsms)

Stage 3 - Convalescent Stage

Lasts about 2-3 weeks; susceptible to other respiratory infections for many

Recovery is gradual. Coughing lessens but fits of coughing may return.

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Clinical Presentation

- Catarrhal Stage
  - Insidious onset, similar to mild respiratory infection
    - Runny nose
    - Low-grade fever
    - Mild, occasional cough
    - Apnea (temporary cessation of breathing)

Clinical Presentation

- Paroxysmal Stage
  - Paroxysms - sudden uncontrollable "fits" or spells of coughing where one cough follows the next without a break for breath (1 - 6 weeks)
  - Inspiratory whoop - high-pitched noise heard when breathing in after a coughing spasm
  - Post-tussive vomiting – vomiting after coughing episodes
  - Exhaustion

Clinical Presentation – Paroxysmal Stage

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Clinical Presentation

- Convalescence Stage
  - Weeks through months
  - Recovery is gradual
  - Coughing lessens, but fits of coughing may return
  - Susceptible to other respiratory infections at this time
- Varies with age and history of previous exposure or vaccination.
  - Infants – apnea (temporary cessation of breathing)
  - More mild in teens and adults with some immunity

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Complications

- Infants hospitalized with pertussis:
  - 1 in 5 get pneumonia
  - 1 in 100 will have convulsions
  - Half will have apnea
  - 1 in 300 will have encephalopathy
  - 1 in 100 will die
- Teens and Adults
  - Loss of consciousness
  - Rib fractures
  - Weight loss
  - Loss of bladder control

CDC Case Definitions

- **Probable**: In the absence of a more likely diagnosis, a cough illness lasting ≥2 weeks, with at least one of the following symptoms: paroxysms of coughing; inspiratory "whoop"; or post-tussive vomiting AND absence of laboratory confirmation; and no epidemiologic linkage to a laboratory-confirmed case of pertussis.

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CDC Case Definitions

- **Confirmed**: Acute cough illness of any duration, with isolation of B. pertussis from a clinical specimen;
  OR
- Cough illness lasting ≥2 weeks, with at least one of the following symptoms: paroxysms of coughing; inspiratory "whoop"; or post-tussive vomiting AND positive PCR
  OR
- illness lasting ≥2 weeks, with at least one of the following symptoms: paroxysms of coughing; inspiratory "whoop"; or post-tussive vomiting AND, contact with a laboratory-confirmed case of pertussis.

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Diagnosis

- Laboratory Tests
  - Culture
  - Polymerase Chain Reaction (PCR)
  - Direct Flourescent Antibody (DFA)
  - Serology

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Laboratory Testing

- Culture
  - Pros:
    - Most specific test; gold standard
    - Available of WV State Laboratory (Office of Lab Services) in Charleston
    - Free when performed by OLS
  - Cons:
    - Difficult to grow the bacteria because requires live organism and special media
    - Results affected by collection method (including timing), transportation and isolation techniques
    - Results take a while to come back

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Laboratory Testing

- PCR
  - Pros:
    - Widely available
    - Detects B. pertussis DNA, does not need live organism
    - Rapid test, results within hours or a few days
  - Cons:
    - Not 100% accurate
    - Difficult to distinguish between species
    - Methods vary among different laboratories
  - CDC Best Practices document
    - www.wvidep.org

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Laboratory Testing

- DFA
  - Pros: Rapid test
  - Cons: Low sensitivity – not highly reliable
- Serology
  - Pros: can be used in adults and adolescents who present to HCP late in the course of illness
  - Cons: Not standardized; Difficult to interpret – serology measures pertussis antibodies, and presence of detectable antibodies can be due to recent or remote vaccination or exposure to disease.

Management

- Manage patients with pertussis and their close contacts according to guidelines
  - Case (patient)
    - Isolation
    - Antibiotics
  - Contacts - anyone who had direct, personal contact with a person who has pertussis during the catarrhal and early paroxysmal stages of infection
    - Asymptomatic – prophylax, vaccinate
    - Symptomatic – evaluate, test, vaccinate, treat, report
- Obtain laboratory confirmation (culture, PCR)
  - Free of charge at OLS

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Recommended Antimicrobial Therapy and Postexposure Prophylaxis for Pertussis in Infants, Children, Adolescents, and Adults

Age	Recommended Drugs			Alternative
	Azithromycin[1]	Erythromycin	Clarithromycin	TMP-SMX[2,3]
< 1 mo	10 mg/kg per day as a single dose for 5 days	40 mg/kg per day in 4 divided doses for 14 days	Not recommended	Contraindicated at < 2 mo of age
1-5 mo	See above	See above	15 mg/kg per day in 2 divided doses for 7 days	≥ 2 mo of age: TMP 8 mg/kgday; SMX, 40 mg/kg/day in 2 doses for 14 days
≥ 6 mo and children	10 mg/kg as a single dose on day 1 (maximum 500 mg); then 5 mg/kg/ day as a single dose on days 2-5 (maximum 250 mg/day)	See above (maximum 2 g/day)	See above (maximum 1 g/day)	See above
Adolescents and Adults	500 mg as a single dose on day 1, then 250 mg as a single dose on days 2-5	2 g / day in 4 divided doses for 14 days	1 g/day in 2 divided doses for 7 days	TMP, 200 mg/day; SMX, 1600 mg/day in 2 divided doses for 14 days

[1]Azithromycin is the preferred agent for infants because of risk of idiopathic hypertrophic pyloric stenosis associated with erythromycin
[2]TMP = trimethoprim and SMX = sulfamethoxazole
[3]TMP-SMX is contraindicated in pregnant women

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Surveillance & Reporting

- Important to learn about disease epidemiology
  - Changing disease patterns
    - Changing risk factors
    - Changes in agent
    - Response to public health programs and interventions – vaccine
  - Outbreaks
  - Advances in science – lab tests, treatment, etc.

Surveillance & Reporting

- Reporting requirements
  - WV rule 64CSR-7:
    - Report suspected and confirmed cases of pertussis to local health department within 24 hours
    - Report outbreaks immediately to health department
  - Federal grant requirement

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Prevention

- The best way to prevent pertussis is through vaccination
  - DTaP – children should get 5 doses
    - Ages 2, 4, 6, and 15 - 18 months and 4 - 6 years.
  - Tdap – Adolescents 11-18 years of age (preferably at age 11-12 years) and adults 19 - 64 years of age should receive a single dose
    - 1 dose for adults ≥ 65 who have not previously received Tdap and have close contact with an infant

Vaccine over Time

- Whole-cell pertussis vaccine developed in 1930 and was widely used in clinical practice by the mid 1940s.
  - After 4 doses, 70-90% effective in preventing serious disease
  - Protection decreased over time with little or no protection 5-10 years after the last dose
  - Concerns over safety lead to more purified (acellular) pertussis vaccine associated with a lower frequency of adverse reactions
    - Acellular pertussis vaccine found to be significantly more effective than whole-cell DTP

Long-Term Trends in the US

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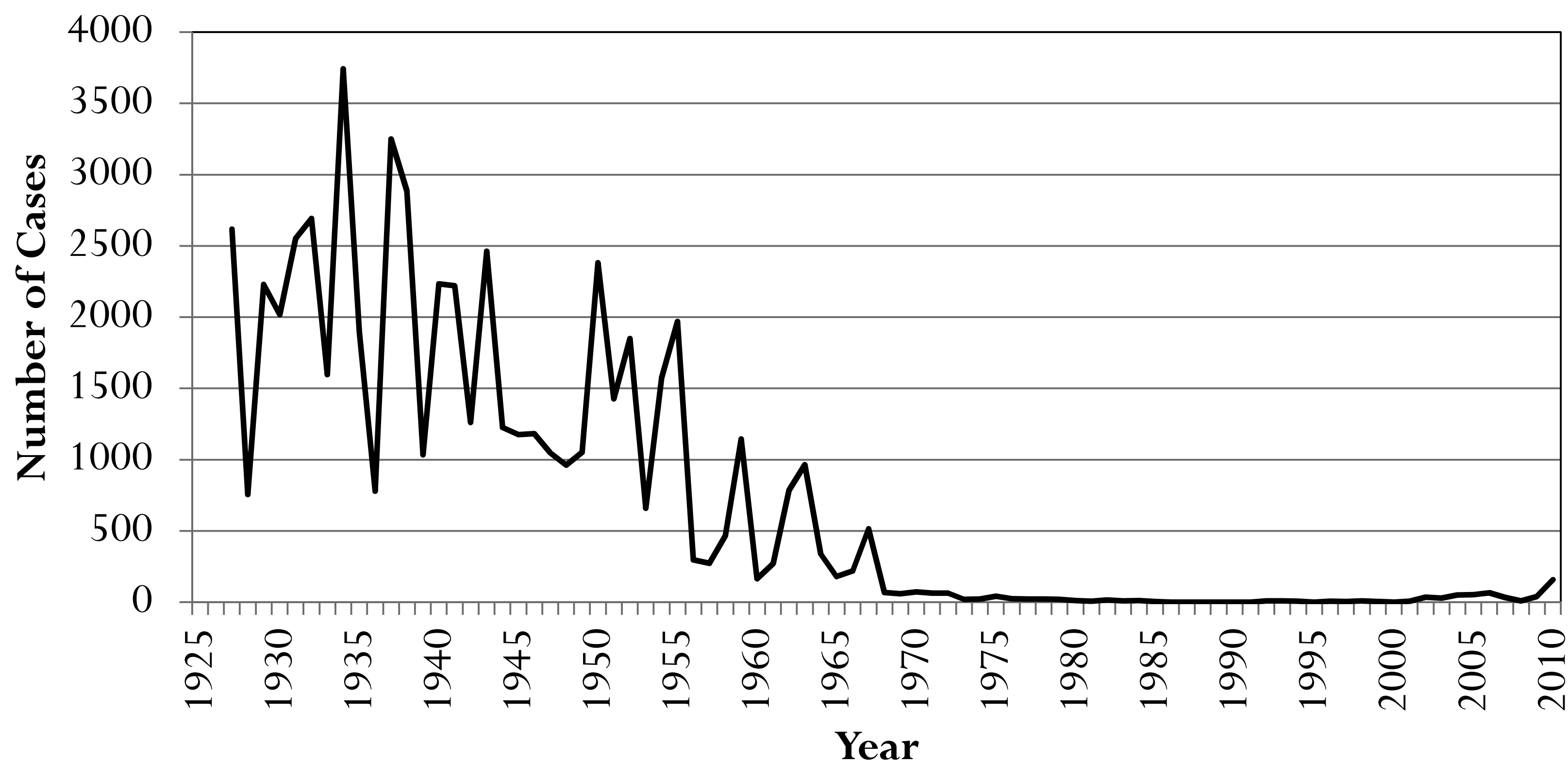
Long-Term Trends in WV



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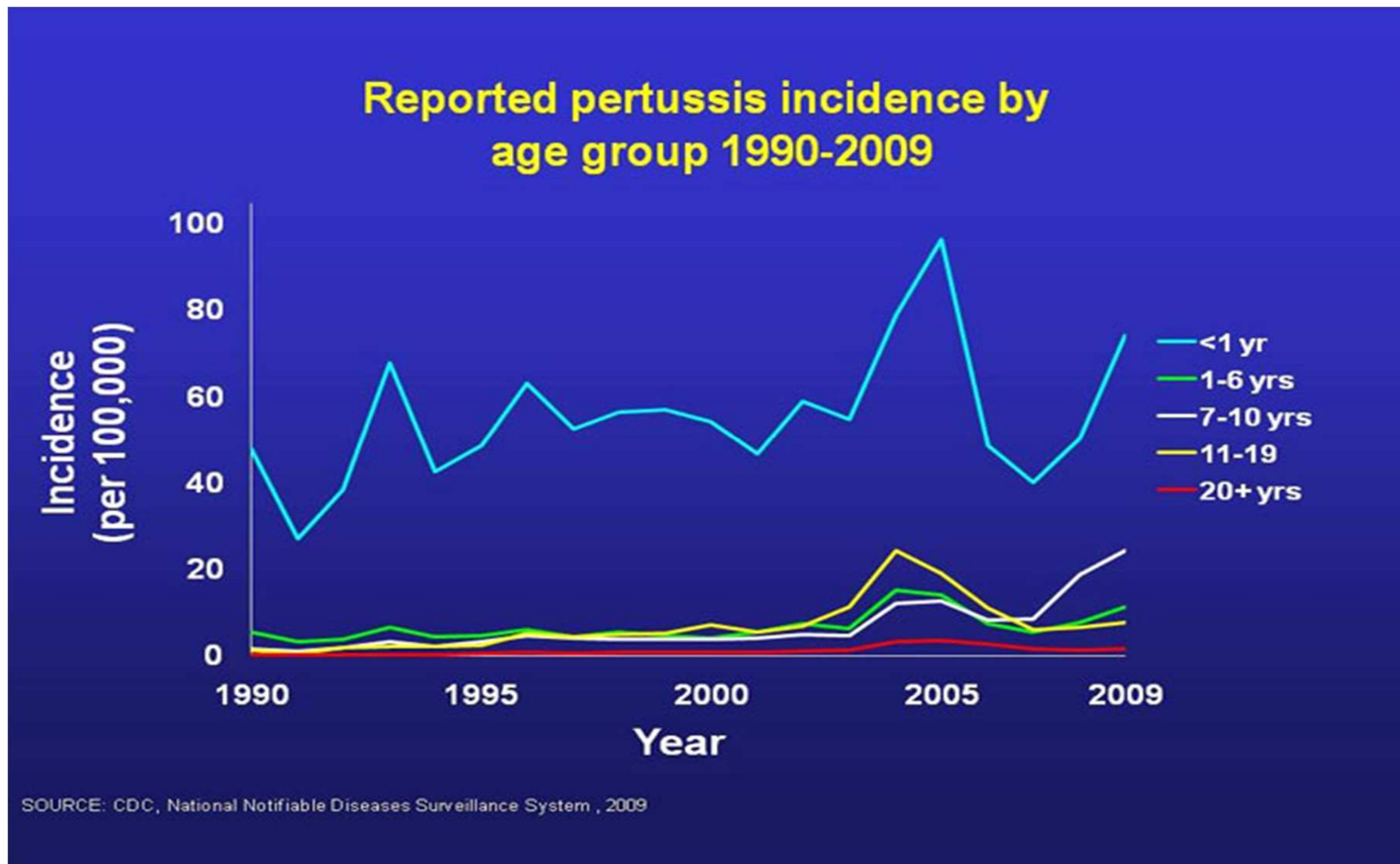
Recent Trends in the US



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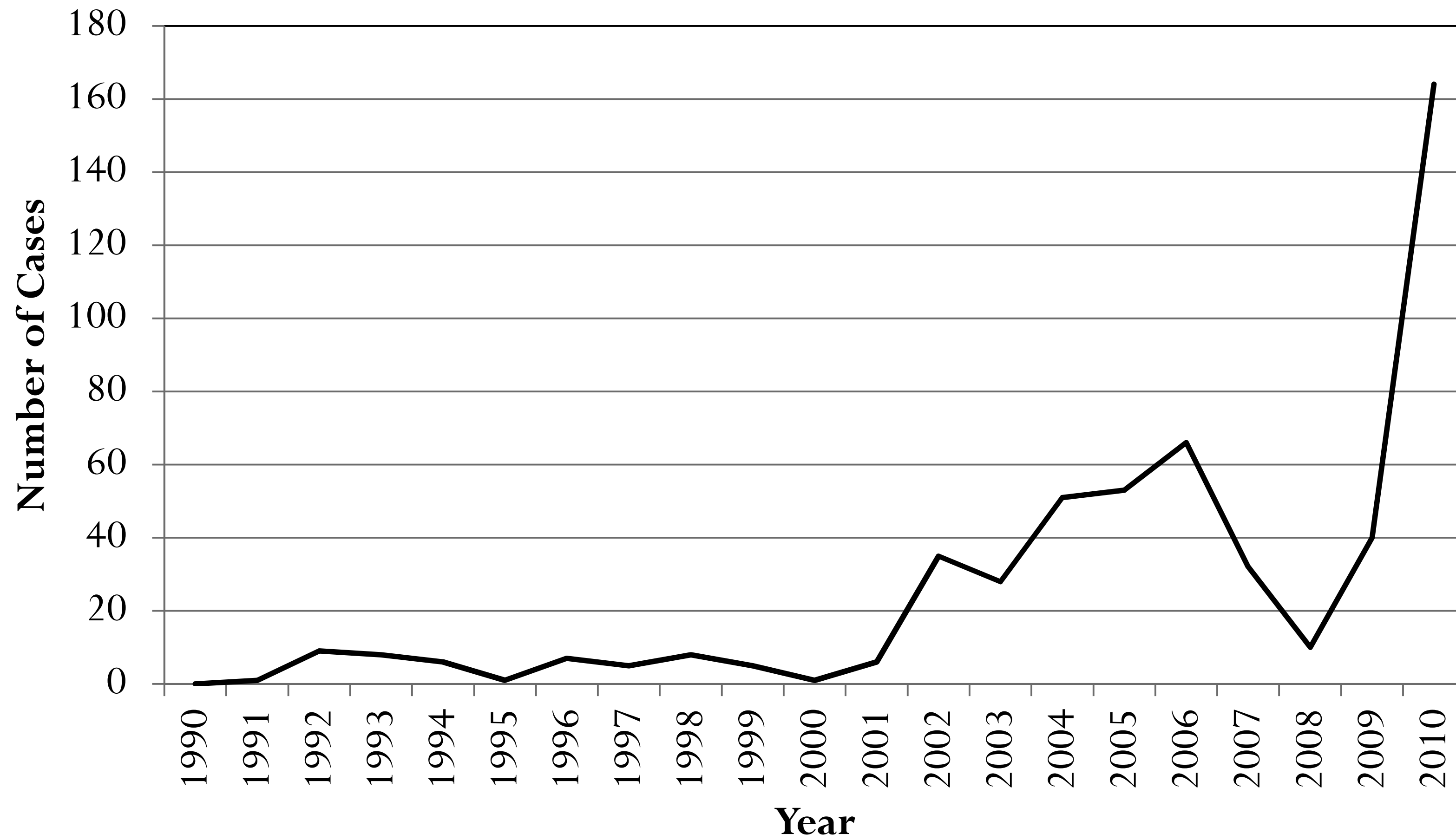
Recent Trends in WV



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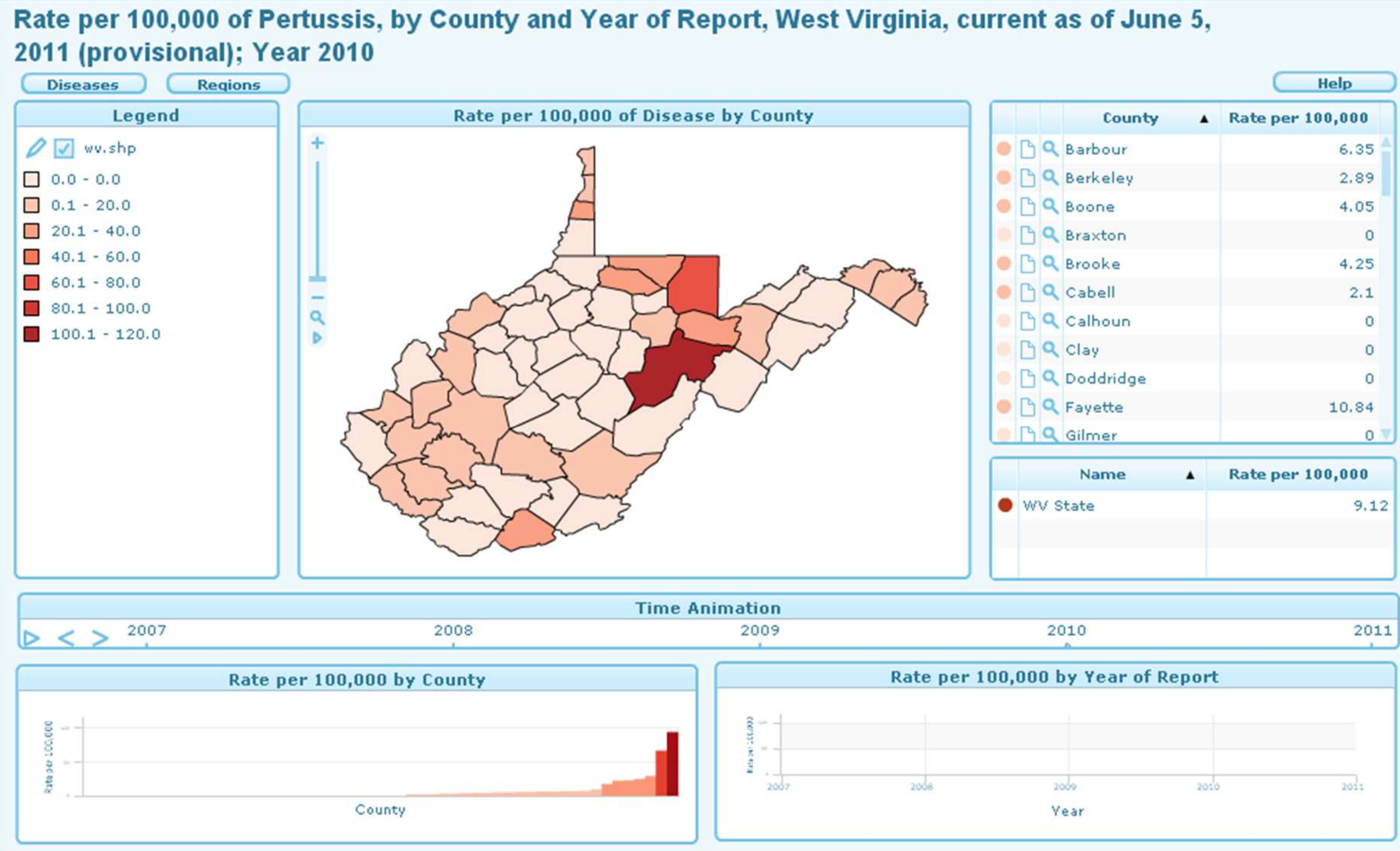
Incidence of Pertussis in West Virginia, 2010



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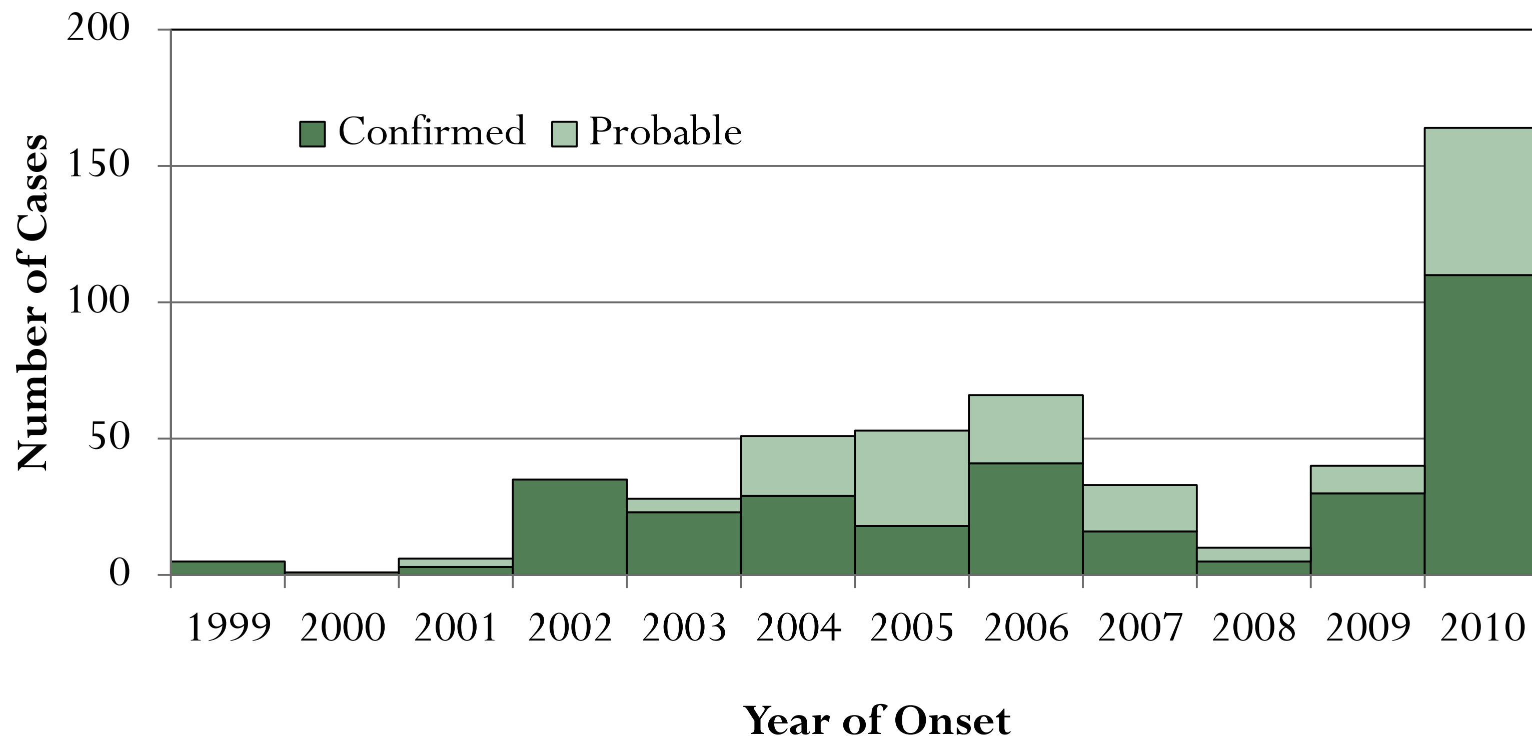
Confirmed and Probable Cases of Pertussis by Year of Onset West Virginia, 1999 – 2010 (N = 492*)



* provisional

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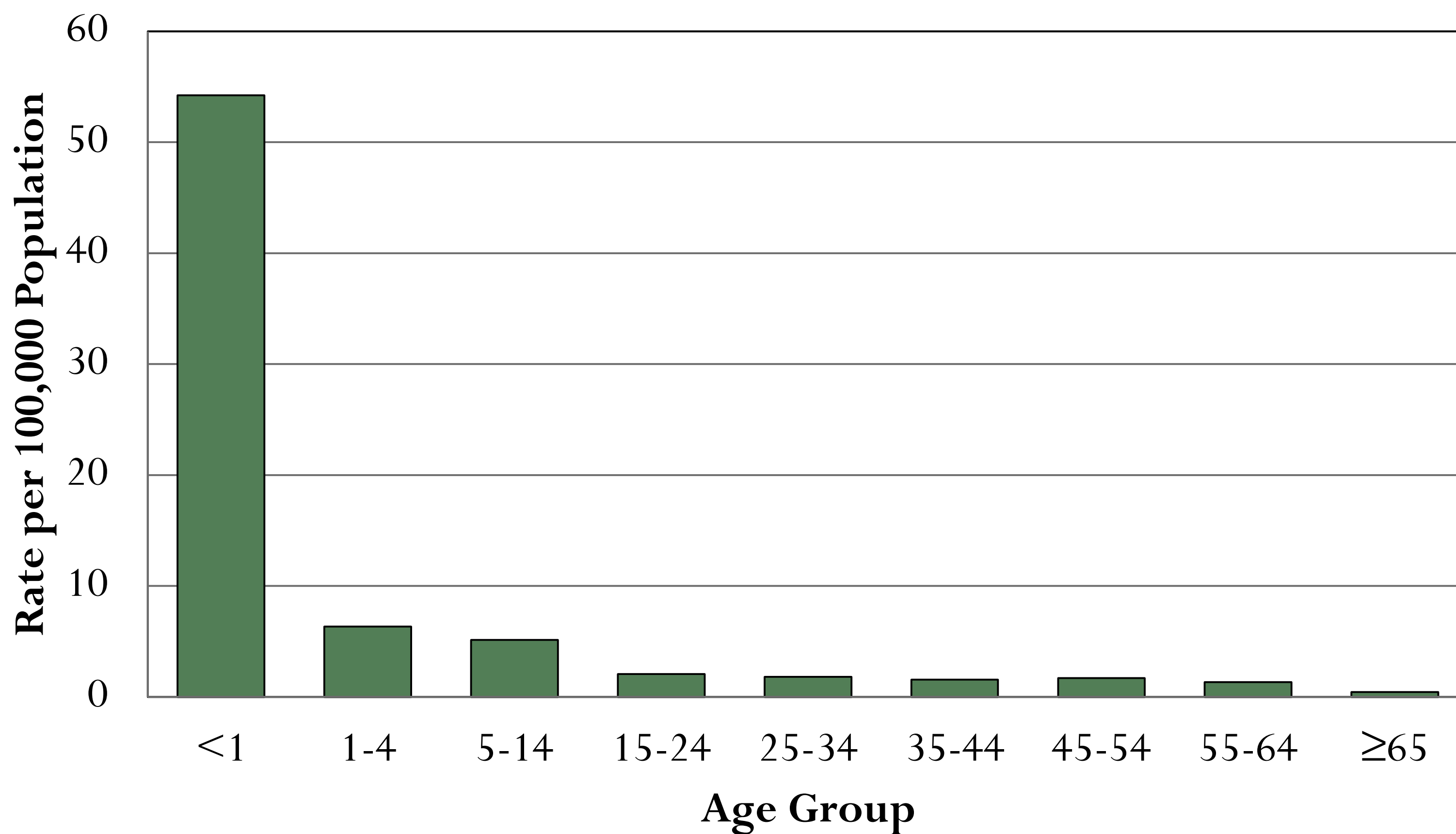
Average Yearly Age-Specific Incidence of Pertussis West Virginia, 1999-2010 (N=492)



*United States Census 2004 data used for incidence calculations. (http://www.census.gov/census2004/states/wv.html)

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20th Century Annual Morbidity vs. Current Morbidity: Vaccine Preventable Diseases

Disease	20th Century Annual Morbidity†	2010 Reported Cases‡	Percent Decrease
Smallpox	29,005	0	100%
Diphtheria	21,053	0	100%
Measles	530,217	61	> 99%
Mumps	162,344	2,528	98%
Pertussis	200,752	21,291	89%
Polio (paralytic)	16,316	0	100%
Rubella	47,745	6	> 99%
Congenital Rubella Syndrome	152	0	100%
Tetanus	580	8	99%
Haemophilus influenzae	20,000	270*	99%

†JAMA. 2007;298(18):2155-2163

‡CDC. MMWR January 7, 2011;59(52);1704-1716. (provisional MMWR week 52 data)

*** 16 type b and 254 unknown serotype (< 5 years of age)**

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Reasons for Increased Number of Cases

- Improvement in surveillance
- Reporting bias
  - More likely to take an infant to the doctor
- Increased use of PRC
  - More accurate diagnoses
- Waning immunity
  - Neither natural history of disease nor vaccination provides life-long immunity

Strategies for Preventing Pertussis

- Surveillance data to refine control measures
- The best way to prevent pertussis is through vaccination
  - What do we do about children < 1 year
    - First DTaP 2 months of age
    - Other doses at 4, 6, and 15 - 18 months and 4 - 6 years
  - Best way to protect them is through herd immunity
    - Where do they acquire their disease?

Who Was the Source?

- According to a 2004 study, the source in 43% of cases:
- Mothers = 32%
- Siblings = 20%
- Fathers = 15%
- Grandparents = 8%
- Others = 25%
  - Including caregivers, friends

- **Family member in 75% of these cases**

- According to a 2007 study, the source in 76%-83% of cases:
- Parents = 55%
- Siblings = 16%
- Aunts/Uncles =10%
- Friends/cousins = 10%
- Grandparents = 6%
- PT caretakers = 2%

- **Family/Household members**

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So what is "Cocooning"?

- The Global Pertussis Initiative (GPI) of 2001 recommended implementation of the cocoon strategy which is defined as:
- Immunization of family member and close contacts of a newborn

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Summary

- Pertussis is a cough illness caused by a toxin-producing bacteria, *Bordetella pertussis*
- Disease can last for weeks/months with no effective treatment for reduction of symptoms, though antibiotics will help reduce transmission
- Occurrence of disease has been increasing in the past couple decades, mostly likely due to waning immunity
- Children < 1 year of age are diagnosed more frequently than any other age group
- We can help protect these children by immunizing their close contacts