Whoop, there it still is: An update on pertussis

March 3, 2016

Michele Cheung, MD MPH, FAAP
Deputy Medical Director, Epidemiology
Physician Specialist, Infectious Disease Preparedness,
Health Disaster Management

Objectives

- As a result of this presentation, participants will be able to:
  - Recognize the clinical features of pertussis
  - Understand the current epidemiology of pertussis
  - Identify challenges in pertussis control and vaccination

Case #1

- 5 month old infant female, no h/o pertussis vaccinations
- Onset June 2015 of cough, post-tussive emesis, decreased oral intake, wheezing, fussiness
  - Developed apnea, admitted to ICU (1 month after onset)
  - Not intubated
  - NP swab PCR positive *Bordetella pertussis*
  - CXR pneumonia
  - Treated with azithromycin x 5 days
- Hospitalized x 10 days

Audio: http://www.pkids.org/diseases/pertussis.html

Case #2 (sibling)

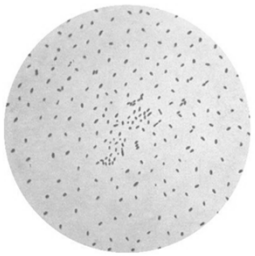
- 20 month old brother, s/p DTaP x 1 only (late)
- Similar onset (June 2015, ~1 week after sister) cough, congestion, paroxysms, post-tussive emesis, color change, decreased oral intake
  - Admitted to ICU with respiratory distress, dehydration (after ~1 month duration)
  - Not intubated
  - Nasal wash PCR positive *Bordetella pertussis*
  - CXR no acute disease
  - Treated with ceftriaxone (initially) and azithromycin
- Hospitalized x 7 days

http://www.pkids.org/diseases/pertussis.html

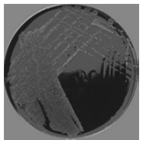
Pertussis Background

- Highly contagious bacterial disease
- Latin *per-* (intensive) + *tussis* (cough)
- Also known as "whooping cough" or "100-day cough"
- Occurs worldwide; all age groups affected but most serious in young infants
- First described France 1414
- First epidemic Paris 1578
- *Bordetella pertussis* isolated in 1906

Bordetella pertussis

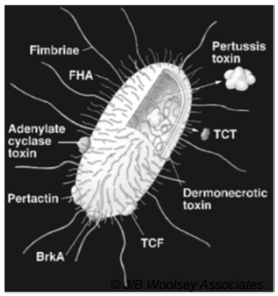


- Gram-negative, pleomorphic, aerobic bacillus
- Fastidious



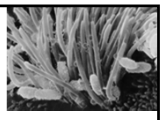
http://www.vaccineinformation.org/photos/pertcdc001a.jpg
Photo courtesy of CDC

Bordetella pertussis
Major Antigens and Virulence Factors

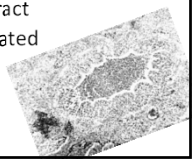


- Pertussis toxin (PT), also known as lymphocytosis- promoting factor (LPF)
- Filamentous hemagglutinin (FHA)
- Pertactin (PRN), also known as 69 kilodalton protein
- Fimbrial agglutinogens (FIM)
- Tracheal cytotoxin
- Adenylate cyclase toxin
- Dermonecrotic toxin
- Lipopolysaccharide (endotoxin)

Pertussis Pathogenesis



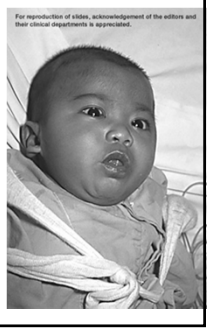
- Primarily toxin-mediated disease
- Organisms attach to cilia of ciliated epithelial cells in respiratory tract
- Pertussis antigens allow evasion of host defenses (lymphocytosis promoted but impaired chemotaxis)
- Inflammation occurs which interferes with clearance of pulmonary secretions
- Local tissue damage in respiratory tract
- Systemic disease may be toxin mediated



CDC Epidemiology and Prevention of Vaccine-Preventable Diseases 2015
Photos: http://www.vaccineinformation.org/photos/pertaap001.jpg
Copyright American Academy of Pediatrics

Clinical Features of Pertussis

- Incubation period: 4-21 days, usually 7 to 10 days
- Insidious onset
- Minimal fever



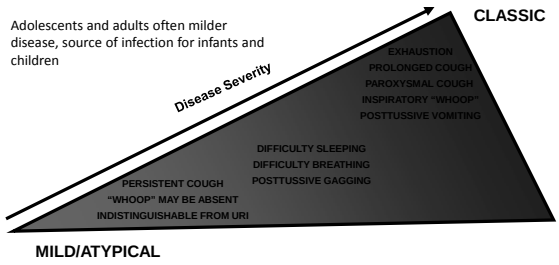
http://www.vaccineinformation.org/photos/pertpmh002.jpg
Copyright Department of Paediatrics and Adolescent Medicine, Princess Margaret Hospital, Hong Kong

AAP *Red Book* 2015; CDC Pink Book 2015

Clinical Features of Pertussis

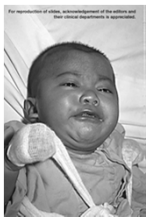
- **Catarrhal stage: 1 to 2 weeks**
  - runny nose, sneezing, low-grade fever, mild cough (cough gradually becomes more severe)
  - similar to minor upper respiratory infection
- **Paroxysmal stage: 1 to 6 weeks**
  - Coughing "fits," post-tussive vomiting, exhaustion
  - Whoops caused by air forcefully inhaled through narrowed glottis
- **Convalescent stage: weeks to months**
  - gradual recovery with less frequent & less severe coughing
  - "100-day cough"
  - Classic pertussis 6-10 weeks duration

Pertussis: Spectrum of Disease



Hewlett EL, Edwards KM. *NEJM*. 2005;352:1215-1222. Lee GM et al. *Clin Infect Dis*. 2004;39:1572-1580.
Wirsing von Konig CH et al. *Lancet Infect Dis*. 2002;2:744-750.
CDC. Epidemiology and Prevention of Vaccine-Preventable Diseases.

"Classic" Pertussis (in Infants)



- Paroxysms
- Inspiratory "whoop"
- Post-tussive vomiting
- Exhaustion
- May have apnea
- Lymphocytosis prominent
- Infants <6 mos may have atypical disease – no whoop; short catarrhal stage; gagging, gasping, apnea (67%)
  - Most severe disease in < 6 mos, especially preterm and unimmunized infants

AAP. *Red Book* 2015
CDC. Epidemiology and Prevention of Vaccine-Preventable Diseases.
Tanaka M et al. *JAMA*. 2003;290:2968-2975.
Photo: http://www.vaccineinformation.org/photos/pertpmh001.jpg

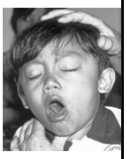
California Pertussis Cases 2014

- Most commonly reported symptoms
  - Paroxysmal coughing – 80%
  - Post-tussive vomiting – 40%
  - Inspiratory "whoop" – 39%
  - Apnea – 19%

http://www.cdph.ca.gov/HealthInfo/discond/Pages/Pertussis.aspx

Pertussis Complications in Infants

Condition	% reported
Hospitalization	>66
Pneumonia	23
Seizures	2
Encephalopathy	<0.5
Death < 2 mos age	1%
Death 2-11 mos age	<0.5

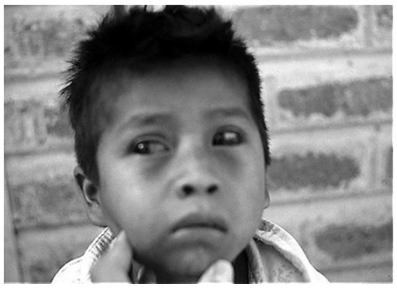


Other complications: apnea, pulmonary hypertension, subdural bleeding, conjunctival bleeding, pneumothorax, hernia, rectal prolapse

2015 AAP Red Book; CDC Pink Book

Photograph courtesy of the WHO: http://www.vaccineinformation.org/photos/pertiac001.jpg

Broken blood vessels in eyes and bruising from coughing



http://www.vaccineinformation.org/photos/pert_wi001.jpg
Photo courtesy of Thomas Schlenker, MD, MPH, Chief Medical Officer, Children's Hospital of Wisconsin

Symptoms in Adolescents & Adults

Clinical Symptoms	At Time of Diagnosis	
	Adolescent	Adult
Paroxysms	83%	87%
Vomiting	45%	41%
Cough >4 Weeks*	41%	52%
Whoop	30%	35%
Apnea	19%	37%
Cyanosis	6%	9%
Hospitalized	1.4%	3.5%

N=3,023-3,037 (*2384) adolescents, 1099-1103 (*871) adults.
Yih WK et al. *J Infect Dis*. 2000;182:1409-1416.

664 Adolescents & Adults w/Pertussis

- Duration of cough
  - Mean 10 weeks adolescents, 12 weeks adults
  - > 3 weeks in 97% of adults
  - > 9 weeks in 47% adolescents, 52% of adults
- Other symptoms/complications
  - post-tussive emesis in 65%
  - otitis media in 4%; weight loss 3%; fainting 2%
  - rib fracture 2% (1% adolescents, 4% adults)
  - urinary incontinence 6% (34% in 50+ F)
  - average 14 days disrupted sleep
- Missed average 5 days of school (teens); 7 days of work (adults)
- Among adults, some complications increase with age

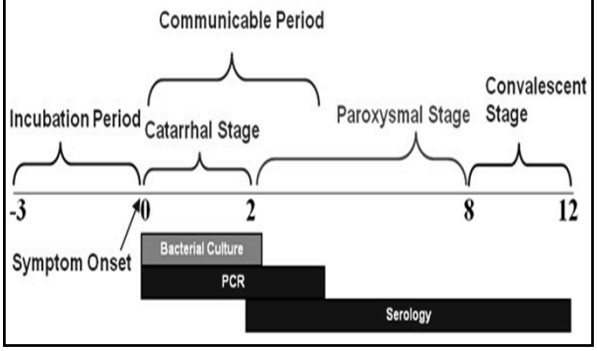
De Serres et al. *J Infect Dis*. 2000;182:174–9. AAP *Red Book* 2015

www.nejm.org/action/showMediaPlayer?doi=10.1056/NEJMicm1111819&aid=NEJMicm1111819_attach_1&area

Diagnosis of Pertussis

- Clinical presentation
- Available laboratory tests
  - Isolation of *B. pertussis* by culture
  - Polymerase chain reaction (PCR) testing
  - Direct fluorescent antibody (DFA) testing – not recommended
  - Serologic testing
- Increased WBC with absolute lymphocytosis suggestive; not always present
  - Markedly elevated WBC associated with poor prognosis in young infants

When Pertussis Tests are Likely to be Positive in Infected People



SUMMARY OF DIAGNOSTIC TESTS FOR PERTUSSIS
Compiled by CDC's Pertussis and Diphtheria Laboratory

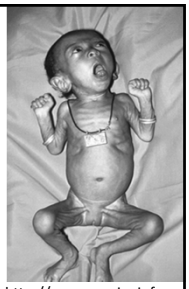
Test	Sensitivity[1,2]	Specificity[1,2]	Optimal Timing	Advantages	Disadvantages
Culture	12 – 60%	100%	< 2 weeks post-cough onset	Very specific [100%]	Low sensitivity; 7-10 day delay between specimen collection and diagnosis
PCR	70 – 99%	86 – 100%	< 4 weeks post-cough onset	Rapid test; more sensitive than culture; organisms do not need to be viable; positive post-antibiotics	No FDA approved tests or standardization; potential for false positives; DNA cross-contamination can be problematic
Paired[3] Sera	90 – 92%	72 – 100%	At symptom onset and 4-6 weeks later	Effective indication of mounting antibody titers	Late diagnosis; no FDA approved tests or standardization
Single[3] Sera	36 – 76%	99%	At least 2 weeks post-cough onset; ideally 4-8 weeks post-cough	Useful for late diagnosis or post-antibiotics	No FDA approved test or standardization; possibly confounded by recent vaccination; diagnostic cut-offs not validated

1 Not part of CDC/CSTE case definition (Exception: MA single point ELISA assay)
2 Sensitivity and specificity values obtained from Wendelboe and Van Rie, 2006
3 Data currently being validated at CDC (except paired sera)

http://www.aphl.org/AboutAPHL/publications/Documents/ID_2010May_Pertussis-Diagnostics-Brochure.pdf

Clinical Management

- Antibiotics
- Supportive care
- Nutrition
- Monitoring of respiratory status
- Droplet Precautions
- Exchange transfusion for profound or rapidly increasing lymphocytosis used in some centers
- Nitric oxide used for pulmonary hypertension in some centers



http://www.vaccineinformation.org/photos/pertcdc002.jpg
Courtesy of CDC

Antibiotic Treatment & Prophylaxis

Age	Recommended Drugs		
Younger than 1 mo	10 mg/kg/day as a single dose daily for 5 days[b,c]	40 mg/kg/day in 4 divided doses for 14 days	Not recommended
1 through 5 mo	See above	See above	15 mg/kg per day in 2 divided doses for 7 days
6 mo or older 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 through 5 (maximum 250 mg/day)[b,d]	40 mg/kg/day in 4 divided doses for 7–14 days (maximum 1–2 g/day)	15 mg/kg/day in 2 divided doses for 7 days (maximum 1 g/day)
Adolescents and adults	500 mg as a single dose on day 1, then 250 mg as a single dose on days 2 through 5[b,d]	2 g/day in 4 divided doses for 7–14 days	1 g/day in 2 divided doses for 7 days

AAP. *Red Book* 2015
CDC. MMWR Recommendations and Reports 12/9/05, 54(RR-14)

Alternative Antibiotic

Age	Alternative TMP-SMX
Younger than 1 mo	Contraindicated at younger than 2 mo of age
1 through 5 mo	2 mo of age or older: TMP, 8 mg/kg/day; SMX, 40 mg/kg/day in 2 doses for 14 days
6 mo or older and children	See above
Adolescents and adults	TMP, 320 mg/day; SMX, 1600 mg/day in 2 divided doses for 14 days

For patients ≥ 2 months of age who are allergic to macrolides or who cannot tolerate macrolides, or who are infected with rare macrolide-resistant strains

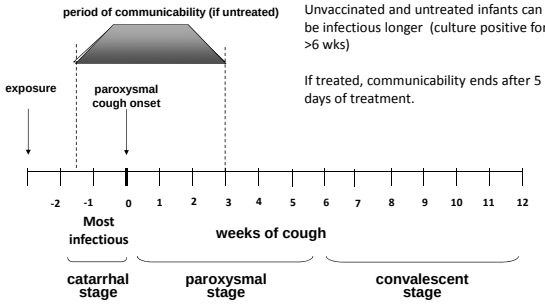
AAP. *Red Book* 2015
CDC. MMWR Recommendations and Reports 12/9/05, 54(RR-14)

Why Treat Pertussis (Cases?)

- Approximately 80-90% of untreated pertussis cases spontaneously clear organism from nasopharynx within 3-4 weeks of onset of cough
  - Untreated and unvaccinated infants may stay culture positive for > 6 weeks
- Treatment may decrease communicability (within 21 days after cough onset)
- Treatment may modify disease course (reduce duration and severity) if administered early
  - Rarely affects disease course after first week of symptoms
- Standard and droplet precautions until 5 days of appropriate antibiotic rx or 21 days after onset of cough if not treated
  - Exclusion from day care 5 days; K-12 school 3 days (CDC recommendations 5 days)

AAP *Red Book* 2015
CDC Epidemiology and Prevention of Vaccine-Preventable Diseases.
Hewlett EL, Edwards KM. *NEJM*. 2005;352:1215-1222.

Pertussis Stages, Period of Communicability



Unvaccinated and untreated infants can be infectious longer (culture positive for >6 wks)

If treated, communicability ends after 5 days of treatment.

CDC. Epidemiology and Prevention of Vaccine-Preventable Diseases. PHF 2004

Who Should Get Prophylaxis?

- Up to 80% of previously vaccinated household contacts of symptomatic cases are infected because of waning immunity
- Antimicrobial prophylaxis to asymptomatic household contacts within 21 days of onset of cough in index patient can prevent symptomatic infection
- Prophylaxis can be considered for:
  - Close contacts of a symptomatic patient with pertussis
    - Face-to-face exposure within 3 feet
    - Direct contact with respiratory, nasal or oral secretions
    - Share same confined space in close proximity for at least 1 hour
  - Regardless of immunization status
- Symptomatic contacts should be treated as cases
- Vaccinate all persons not up-to-date for pertussis vaccine (including Tdap)
- Contacts should self-monitor for symptoms 21 days; report to Public Health if symptoms

CDC. MMWR 2005;54 (RR-14) and CDPH "Pertussis: Public Health Investigation"

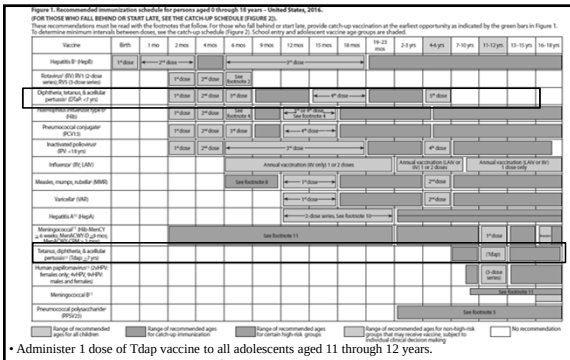
Contact Management

- Priority to prophylaxis contacts with high risk for severe disease and those who may transmit to those at high risk
  - Infants < 12 months of age
  - Pregnant women
  - Persons with immunodeficiency, chronic lung disease, neuromuscular disease
  - Unimmunized/underimmunized infants and children
  - Caregivers/household/childcare contacts infants/pregnant women
- Prophylaxis available through Public Health if patient unable to obtain in a timely manner due to financial or other reasons

AAP 2015 *Red Book*
CDC. MMWR 2005;54 (RR-14) and CDPH "Pertussis: Public Health Investigation"

Prevention – Vaccination is key

- Pregnant women are recommended to receive Tdap in their 3rd trimester (27-36 weeks gestation), during <u>each</u> pregnancy
- Infants can start the childhood vaccine series (DTaP) as early as 6 weeks of age.
  - Even one dose of DTaP may offer some protection against fatal disease.
  - Five doses (2, 4, 6, 15-18 months, and 4-6 years) are needed by kindergarten
- Tdap booster is recommended at age 11-12 years; may be given as early as 7 years of age.
  - Required in California for 7th grade
- Adults are recommended to receive a Tdap booster
  - Especially if they are in contact with infants or health care workers



- Administer 1 dose of Tdap vaccine to all adolescents aged 11 through 12 years.
- Tdap can be administered regardless of the interval since the last tetanus and diphtheria toxoid-containing vaccine.
- Administer one dose of Tdap vaccine to pregnant adolescents during each pregnancy (preferred during 27 through 36 weeks gestation) regardless of number of years from prior Td or Tdap vaccination.

From CDC NIP http://www.cdc.gov/vaccines/schedules/hcp/child-adolescent.html

Pertussis Containing Vaccines in the U.S.

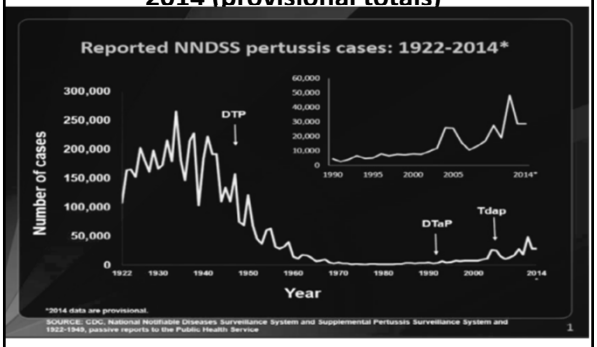
Pharmaceutical	Manufacturer	Pertussis Antigens	Recommended Use
DTaP Vaccine for Children Younger Than 7 Years of Age			AAP *Red Book* 2015
DTaP (Infanrix)	GlaxoSmithKline Biologicals	PT, FHA, pertactin	**All 5 doses,** children 6 wk through 6 y of age
DTaP (Daptacel)	Sanofi Pasteur	PT, FHA, pertactin, fimbriae types 2 and 3	**All 5 doses,** children 6 wk through 6 y of age
DTaP-hepatitis B-IPV (Pediarix)	GlaxoSmithKline Biologicals	PT, FHA, pertactin	**First 3 doses, children 6 wk through 6 y of age; usual use** at 6- to 8-wk intervals beginning at 2 mo of age; then 2 doses of DTaP are needed to complete the 5-dose series before 7 y of age
DTaP-IPV/Hib (Pentacel)	Sanofi Pasteur	PT, FHA, pertactin, fimbriae types 2 and 3	**First 4 doses, children 6 wk through 4 y of age; usual use** at 2, 4, 6, and 15 through 18 mo of age; then 1 dose of DTaP is needed to complete the 5-dose series before 7 y of age
DTaP-IPV (Kinrix)	GlaxoSmithKline Biologicals	PT, FHA, pertactin	**Booster dose** for **fifth dose** of DTaP and **fourth dose** of IPV at 4 through 6 y of age
DTaP-IPV (Quadracel) *(MMWR 9/4/2015)*	Sanofi Pasteur	PT, FHA, pertactin, fimbriae types 2 & 3	**Booster dose** for **fifth dose** of DTaP and **fourth or fifth dose** of IPV at 4 through 6 years who have received 4 doses of DTaP-IPV/Hib or DtaP
Tdap Vaccines for Adolescents and Adults			
Tdap (Boostrix)	GlaxoSmithKline Biologicals	PT, FHA, pertactin	**Single dose** at 11 through 12 y of age instead of Td (see text for additional recommendations) Adults
Tdap (Adacel)	Sanofi Pasteur	PT, FHA, pertactin, fimbriae types 2 and 3	**Single dose** at 11 through 12 y of age instead of Td (see text for additional recommendations) Adults (through 64 years of age)

Pertussis Epidemiology

- Reservoir — Humans only hosts; Adolescents and adults; Immunity not lifelong
- Seasonality — Year-round, typically late summer-autumn peak
- Transmission — Close contact via respiratory droplets
- Communicability — Maximum in catarrhal stage; Secondary attack rate up to 70-100%; Highly contagious; R_o 12-17

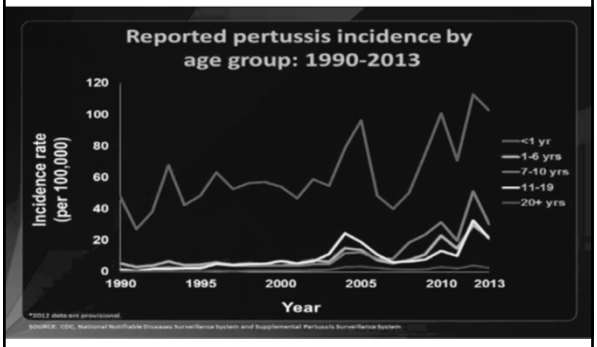
CDC NIP. Epidemiology and Prevention of Vaccine-Preventable Diseases
AAP. *Red Book* 2015

U.S.: 28,639 cases in 2013; 28,660 cases in 2014 (provisional totals)



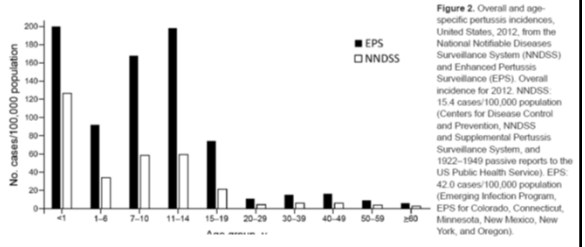
http://www2.cdc.gov/vaccines/ed/epvreg/EPV7.asp; aired 8/19/15

51% of cases in ≥11 years – need Tdap!



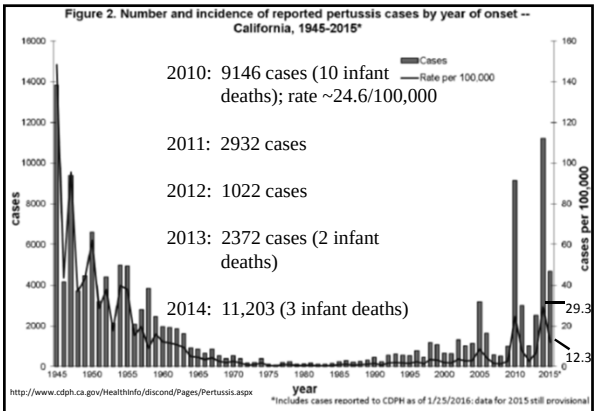
http://www2.cdc.gov/vaccines/ed/epvreg/EPV7.asp; aired 8/19/15

Age-specific Pertussis Incidence

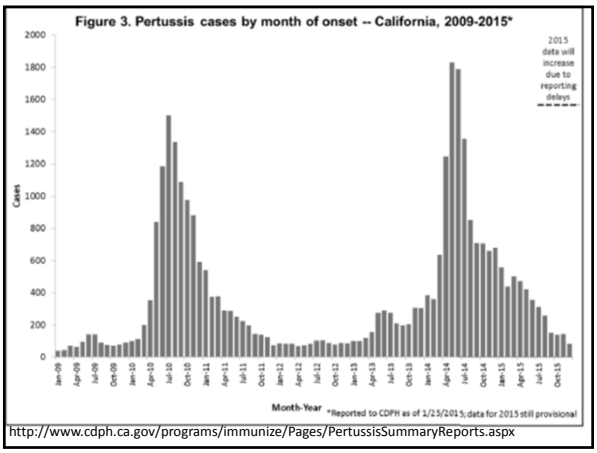


- Enhanced Pertussis Surveillance (EPS) through 6 states of Emerging Infections Program

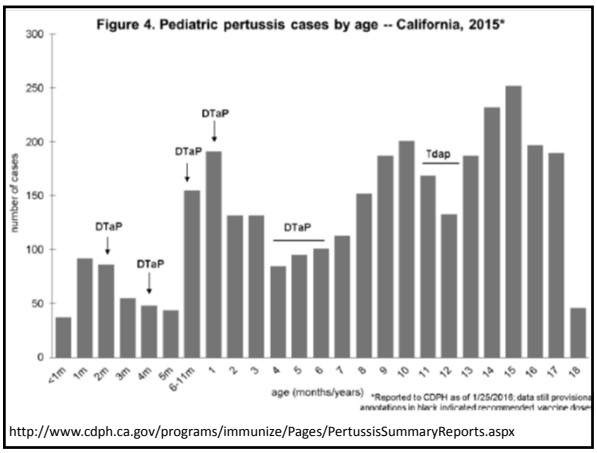
Emerging Infectious Diseases 9/2015



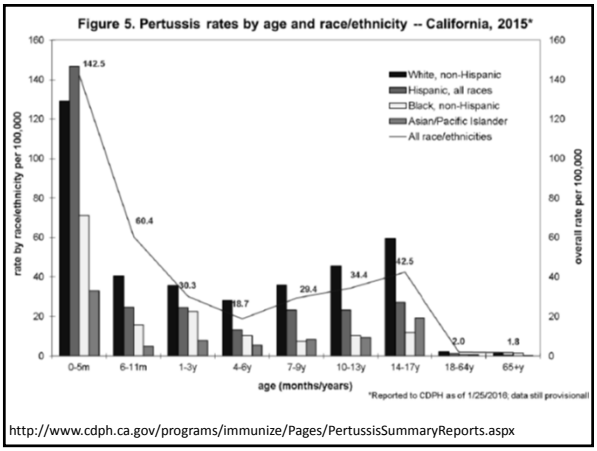
2015: 4,683 (1 infant death) as of 1/25/2016; 198 hospitalized (28% ICU)



http://www.cdph.ca.gov/programs/immunize/Pages/PertussisSummaryReports.aspx



http://www.cdph.ca.gov/programs/immunize/Pages/PertussisSummaryReports.aspx

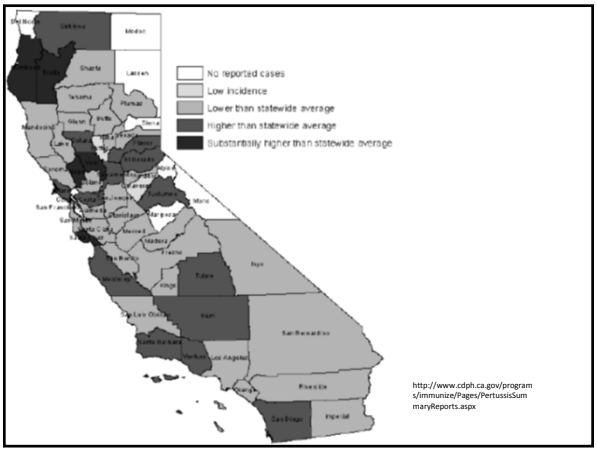


http://www.cdph.ca.gov/programs/immunize/Pages/PertussisSummaryReports.aspx

Pertussis in California

- 2015: State rate 12.3/100,000 persons
  - 1 death in child <3 weeks of age
  - 69% hospitalized patients < 4 months of age
- 2014 – highest number of pertussis cases in CA in over 60 years
  - 11,213 cases; 458 (4%) hospitalized
  - 280 (61%) of hospitalized patients <4 months of age
  - 3 deaths with disease onset in 2014; all ≤5 weeks of age
  - Median age of cases = 12 years (range, 0-99)
  - 9,902 (89%) ≤ 18 years of age
    - ► 755 (8%) <6 months of age; 2,631 (27%) were 14-16 years of age
    - ► Of 9,036 6 month-18 years of age, 7,450 (82%) at least 1 dose pertussis vaccine; 480 (5%) unimmunized; 1,106 (12%) unknown status
  - Rates highest in Hispanic infants < 1 year of age
  - Among children/adolescents, rates highest in non-Hispanic Whites

http://www.cdph.ca.gov/Healthinfo/discond/Pages/Pertussis.aspx



http://www.cdph.ca.gov/programs/immunize/Pages/PertussisSummaryReports.aspx

Challenges in Pertussis Control and Vaccination

- Vaccine-preventable since 1940s
- Increased incidence since 1990s despite widespread childhood vaccination
- Booster vaccine (Tdap) approved for adolescents & adults in 2005
- Cyclical incidence with peaks every 3-5 years

Herd Immunity Thresholds for Selected Vaccine-Preventable Diseases

Disease	R_o	Herd Immunity
Diphtheria	6-7	85%*
Measles	12-18	83-94%
Mumps	4-7	75-86%
Pertussis	12-17	92-94%
Polio	5-7	80-86%
Rubella	6-7	83-85%
Smallpox	5-7	80-85%

***4 doses**

† Modified from *Epid Rev* 1993;15: 265-302, *Am J Prev Med* 2001; 20 (4S): 88-153, *MMWR* 2000; 49 (SS-9); 27-38

http://www.bt.cdc.gov/agent/smallpox/training/overview/ppt/eradicationhistory.ppt#513

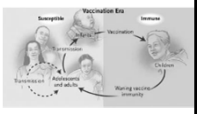
Pertussis resurgence since the 1990s

- Neither vaccination nor natural disease confers complete or lifelong immunity against pertussis or reinfection
- DTaP vaccine efficacy versus previous whole cell DTP vaccine efficacy
  - acellular pertussis vaccines licensed in 1991 for 4th/5th doses; entire series in 1996
- Waning of vaccine-induced immunity and lack of natural booster events
  - Decay in antibody over time
  - Also waning maternal immunity and reduced transplacental antibody in mothers who do not receive Tdap during pregnancy
- Greater awareness of pertussis by clinicians
- General availability of better laboratory tests (PCR)
- Genetic changes in *B. pertussis*
  - Some pertactin-deficient *B. pertussis* strains

Source: CDPH Immunization Branch; AAP 2015 *Red Book*

Factors relating to DTaP vaccine failure

- Per Dr. Cherry
  - Decay in antibody over time
  - T helper (Th) 1/Th2 versus a Th1, Th17 cellular response
  - Incomplete antigen package
  - Incorrect balance of antigens in vaccine
  - Linked epitope suppression
  - Occurrence of pertactin-deficient *B. pertussis* strains



Cherry. Epidemic Pertussis and Acellular Pertussis Vaccine Failure in the 21st Century. Pediatrics June 2015

Outbreak in Vaccinated 1-5 y.o. Children

- Sept 2013 in Florida – 5 month period
- Index 1 y.o. preschool attendee – lab confirmed pertussis
  - Source 3 y.o. sibling
- School with 117 students (10 months-6 years of age); 26 staff
- 26 (22%) students 1-5 years of age, 2 (7%) preschool staff, 11 epi-linked persons (9 HH, 2 camp counselors) met case definition for pertussis
  - 11 confirmed; 28 probable
  - 4 hospitalized
  - Only 5 students (including 2 with pertussis) not completely vaccinated against pertussis
  - Attack rate 50% in one classroom UTD for pertussis (teacher case); 6 classrooms AR > 20%.
  - 2 classrooms with 3 y.o.'s highest AR – children 2-3 y.o. 2.2x (95% CI, 1-4.9) higher risk for pertussis than 4-6 y.o.

EID February 2016

http://www2.cdc.gov/vaccines/ed/epvreg/EPV7.asp; aired 8/19/15

Source of infection changed

- Enhanced Pertussis Surveillance 2006-2013 – cases < 1 y.o.
  - Potential source of infection (suspect pertussis case in contact with infant 7-20 days prior to onset) [SOI]
- 1306 infants; 24.2% < 2 months old
  - SOI identified in 569 (44%) of cases
  - Infants 0-1 months old more likely to have SOI than infants 2-11 months old (54.1% vs 40.2%, p<0.0001)
  - More than 66% SOIs were immediate family members
    - ► 35.5% siblings; 20.6% mothers; 10% fathers
    - ► Mothers predominated until 2008, then siblings
  - SOI median age 14 y.o. (0-74 years); for siblings median age 8 y.o.
    - ► 2006-2009 median age 18 y.o. vs 2010-2013 median age 12 y.o. (p=0.0160)

Pediatrics October 2015

Source of infection over 2006-2013

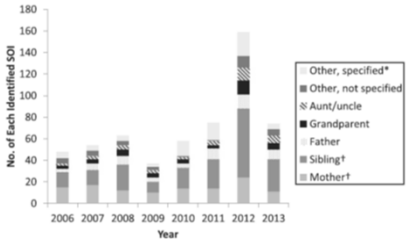


FIGURE 2
Relationship of identified sources of infection, by year, 2006–2013. * Includes day-care contacts, cousins, friends, babysitters, and nieces/nephews, unknown source ($n = 1$). † $P < .05$.

- Proportion of mother SOI decreased (p.=0.0014; sibling SOI increased (p=0.0333)

Pediatrics October 2015

Source of infection by age group of case

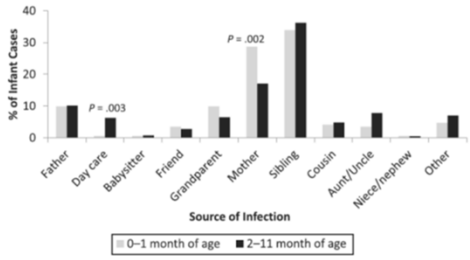


FIGURE 3
Differences in relationship of identified SOIs, by case infant age, 2006–2013.

Pediatrics October 2015

Tdap waning immunity

- Adolescents during 2012 statewide Wisconsin outbreak (273,420)
  - Residents born between 1998-2000; Tdap histories through registry
  - Lab-confirmed pertussis cases onset 2012 (739)
- Vaccine effectiveness decreased with time since receipt
  - 75.3% (95% CI, 55.2-86.5%) for receipt during 2012
  - 68.2% (95% CI, 60.9-74.1%) for receipt during 2011
  - 34.5% (95% CI, 19.9-46.4%) for receipt during 2010
  - 11.9% (95% CI, -11.1%-30.1%) for receipt during 2009/2008
- Point estimates higher among Boostrix recipients than Adacel; among Tdap recipients, receipt of Boostrix (vs Adacel) associated with decreased risk of pertussis (adj IRR 0.62 (95% CI 0.52-0.74)
  - Difference may not be generalizable as primary series DTaP vaccines not evaluated

Journal of Infectious Diseases September 2014

Tdap waning immunity (2)

- Kaiser Permanente Northern California – members who had received all DTaP products (279,493)
- Reviewed patients >=10 years of age positive for pertussis (1207)
- 90% Tdap coverage rate
- On the basis of 1207 pertussis cases, Tdap VE during the first year after vaccination was 68.8% (95% confidence interval [CI] 59.7% to 75.9%), decreasing to 8.9% (95% CI –30.6% to 36.4%) by ≥4 years after vaccination.
- Adolescents who were more remote from Tdap were significantly more likely to test positive for pertussis than were those vaccinated more recently (hazard ratio per year 1.35, 95% CI 1.22 to 1.50).

Pediatrics March 2016

"We desperately need a new pertussis vaccine.

Every indication is that large-scale pertussis outbreaks will continue until a new approach is developed.

In the meantime, the best primary strategy to prevent infant deaths is to immunize every pregnant woman during every pregnancy and to present the immunization schedule as the standard of care rather than as an option."

Tdap in Every Pregnancy: Circling the Wagons Around the Newborn

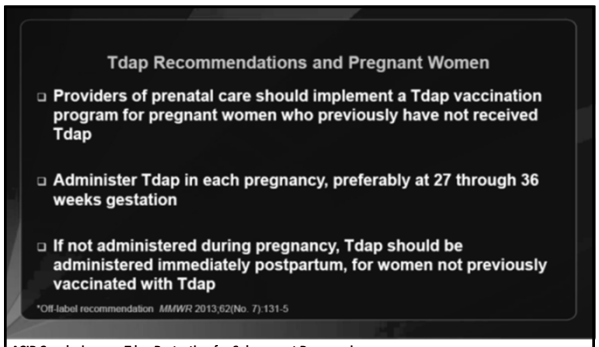
Mark H. Sawyer, MD[a], Sarah S. Long, MD[b]

Pediatrics June 2015

Tdap during pregnancy

- Tdap immunization rates during pregnancy currently <20%, despite recommendations from CDC, AAP, ACOG, AAFP
- Northern California Kaiser concentrated efforts attained 83.9% rate in 2014
- "Cocooning" difficult to implement
  - Highly variable success – 19-85% of family members other than mother immunized in various studies
  - National pertussis immunization coverage 25.9% for adults (19-64 years of age) living with infant <1 year of age in 2012
  - Barriers: insurance coverage; reluctance of provider to immunize other family members besides patient; poor adherence of family members to go to own provider for immunization; immunization records

Pediatrics June 2015



ACIP Conclusions re: Tdap Protection for Subsequent Pregnancies

- Maternal antibodies from women immunized before pregnancy waned quickly (Healy 2012)
  - Concentration of maternal antibodies unlikely high enough to provide passive protection to infants
- A single dose of Tdap at one pregnancy is insufficient to provide protection for subsequent pregnancies

http://www2.cdc.gov/vaccines/ed/epvreg/EPV7.asp; aired 8/19/15

ACIP Conclusions Safety of Tdap for Every Pregnancy

- Data reassuring on 2 doses of Tdap
- Data and experience with tetanus toxoid vaccine suggest no excess risk of adverse events
  - ~5% of women would receive 4 or more doses
- CDC provides ongoing monitoring to address concerns about the safety of Tdap given during subsequent pregnancies

http://www2.cdc.gov/vaccines/ed/epvreg/EPV7.asp; aired 8/19/15

Survey of Orange County Pharmacists, 2014

- 38 pharmacies called by Epidemiology intern and asked for repeat Tdap for pregnancy
  - 13 said vaccination not necessary
  - 2 were not sure
  - 4 said yes if obstetrician recommends
  - 9 said yes but not necessary
  - 10 said yes

Source: OCHCA Epidemiology

Key points

- Pertussis continues to circulate
- We will continue to have epidemics every 3-5 years
- Need to have better vaccines
- Need to ensure pregnant women are vaccinated during each pregnancy!

Remember all suspect, probable and confirmed pertussis cases are reportable within 1 working day to Epidemiology 714-834-8180

Sign up for newsletters/ alerts
atepi@ochca.com
714-834-8180
www.ochealthinfo.com

ochealth CARE AGENCY