Pertussis Epidemic in California

CA Department of Public Health
Pertussis (whooping cough)

- Caused by *Bordetella pertussis*
- Primarily a toxin-mediated disease; bacteria attach to cilia of respiratory epithelial cells
- Most severe disease and death occurs in infants <4 months of age
- Highly infectious; R0 estimated to be 15-17
- Has been described in writings as early as 14^{th} century and first isolated by Bordet and Gengou in 1906
Pertussis epidemiology

• Cyclical peaks (every 3-5 years) have been increasing nationwide since 1990s
  ▪ 2010 pertussis epidemic in CA with >9,000 cases
  ▪ Many other states observed peaks in 2012 - highest disease incidence since mid-1950s
  ▪ Incidence in CA has been increasing again since mid-2013 and now in the midst of another epidemic year
• In particular, incidence among older children and adolescents has been increasing nationwide consistent with the cohort of children who have only received acellular vaccine
Number and incidence of reported pertussis cases by year of onset – California, 1946-2014*

*Includes cases reported to CDPH as of 9/15/2014
Current situation in CA - as of 9/15/2014

• 8,278 reported cases with 2014 onset; state rate is 21.7 cases/100,000 (150/100,000 prevaccine era)
  ▪ Activity appears to be trending down, but still on track to surpass the number of cases reported during the last epidemic in 2010 (9,159 cases, 24.6/100,000)

• 288 cases hospitalized; 68 (24%) have required intensive care
  ▪ Most (211; 73%) hospitalized were <6 months of age

• 1 death reported in infant 5 weeks old at onset
  ▪ 2 additional infants died in 2014 who had disease onset in 2013 at <2 months of age
Burden of disease in children (CA)

• Most (89%) cases are <18 years of age
• Peak age of disease activity beyond infancy in 2014 is 14-16 year-olds; 27% of pediatric cases are in this age group
  ▪ Less than 0.5% of cases in this age group were hospitalized; none severely ill
  ▪ Nearly all (98%) with data were vaccinated; median time since last pertussis vaccine was 3 years
• In contrast, 12% of pediatric cases are <1 year
  ▪ 30% were hospitalized
• In 2010, peak age of incidence was infants <1 year and 10 year-olds
Incidence of reported pediatric pertussis cases by age – California, 2014*

*Reported to CDPH as of 9/15/2014

Annotations in black indicated recommended vaccine doses.
Why has the incidence of pertussis been increasing?

- Use of acellular vaccines (DTaP and Tdap), which replaced whole-cell vaccine (DTP) in the 1990s
- PCR more sensitive and widely available
- More clinician and public awareness of pertussis
- Possibly due to genetic changes in *B. pertussis*
  - Recent increase in identification of strains in the USA and other countries which no longer express pertactin antigen

Pertussis vaccines - background

• Whole-cell pertussis vaccine (DTP) is composed of a suspension of formalin-inactivated *B. pertussis* cells
  ▪ Developed in 1930s; in wide use by 1940s
  ▪ 70%–90% effective in preventing serious pertussis disease after primary series of 4 doses
  ▪ Protection decreased with time
    ✓ Little or no protection 5 to 10 years following last dose
  ▪ DTP not licensed for anyone older than 6 years of age

• Acellular pertussis vaccines are subunit vaccines that contain purified, inactivated components of *B. pertussis*
  ▪ Less reactogenic, but less effective than whole cell vaccines
  ▪ DTaP recommended in 1992 for the 4\(^{th}\)/5\(^{th}\) doses of childhood series and for entire series in 1997
  ▪ Tdap licensed in 2005 for adolescents and adults
New data on DTaP duration of protection

• Recent studies conducted during and after the 2010 pertussis epidemic indicate that immunity from DTaP vaccine is high immediately following receipt but quickly wanes within a few years\(^1-3\)

• Three studies also suggest that immunity wanes faster in children and adolescents born in 1998 and later who have only received acellular pertussis vaccines (DTaP and Tdap)\(^4-6\) (i.e., no doses of whole-cell vaccine)

5. Sheridan et al. Number and order of whole cell pertussis vaccines in infancy and disease protection. JAMA. 2012
6. Witt et al. Reduced risk of pertussis among persons ever vaccinated with whole cell pertussis vaccine compared to recipients of acellular pertussis vaccines in a large US cohort. CID. 2013;56.
New data on Tdap duration of protection

• Recent studies on Tdap effectiveness shows moderate short-term protection (75%) and rapid waning of immunity 2-4 years after receipt\(^1,2\)

• N. California Kaiser study estimated Tdap to be 53% (41.9%-62.0%) and 64.0% (55.5%-70.9%) effective among adolescents and adults\(^3\)

The “New Normal” of Pertussis

• Increased incidence is the new normal of pertussis
• School and community outbreaks continue to occur even in highly vaccinated populations
• Prevention efforts should be targeted at preventing infection, severe disease, and death in young infants
• Educational materials/communications should be targeted towards healthcare providers, especially prenatal care providers, who can most influence patients
Prioritization of Public Health Activities

- Realigning public health activities with priority to prevent hospitalization and death from pertussis
  - Convened a working group of 20+ LHD representatives to revise case investigation, contact and outbreak management and reporting processes
  - Consulted with health risk communicator Peter Sandman
- Targeting materials/communications to healthcare providers, especially prenatal care providers, who can most influence patients
- Encouraging greater uptake of Tdap vaccine among pregnant women identified as key area of need
Tdap for pregnant women

• CDC/CDPH feel this is the most important strategy to prevent infection in infants who are too young to be vaccinated and at greatest risk for severe disease

• ACIP, ACOG and AAFP recommend Tdap vaccine during each pregnancy, preferably in the third trimester between 27-36 weeks gestation, regardless of their Tdap vaccination history
  ▪ Antibodies to pertussis are actively transported across the placenta to the baby\(^1,2\)

• Preferred over “cocooning” strategy since offers direct protection to the infant

Pertussis cases, hospitalizations and deaths in infants, by age in weeks at time of disease onset -- California, 2010-2014*

Gap in protection

*reported to CDPH as of 9/15/2014
Tdap for pregnant women - available data indicates it is safe and effective

- Data from Australia suggest infants born to vaccinated mothers have lower risk of disease (OR 0.60)\(^1\)
- UK Tdap program for pregnant women estimates 90% reduction in disease in infants <2 months of age; coverage now ~60%\(^2\)
- Repeated doses shown to be safe\(^3\)
- Uptake of Tdap among pregnant women in CA is suboptimal but may be improving
  - 20-25% (2013 CDPH survey of labor and delivery hospitals; being repeated this fall)
  - 76% among N. CA Kaiser (Q2 of 2014)

1. McIntyre. The cocoon strategy to prevent early pertussis – Australian experience. June 2013 ACIP meeting.
Tdap for pregnant women - barriers

• Covered benefit under Medi-Cal and private insurers, but many prenatal care providers do not carry in their offices
• Managed care plans may require that vaccines be administered by primary care providers
• Pharmacies may require Rx to vaccinate pregnant women
• Manufacturers cannot promote Tdap for pregnant women
Tdap for pregnant women - CDPH solutions

- CDPH investigating reports of reimbursement difficulties with Tdap for pregnant women
  - CDPH distributed a summary of correct billing codes and is working with Medi-Cal in an attempt to reduce reimbursement issues
- Distributed state-purchased Tdap vaccine to LHDs and CHCs for pregnant women
- Sponsored webinar on Tdap targeted at OB/GYN practices offering CEU/CMEs
- Distributed educational materials and Tdap vaccine prescription pads to all prenatal providers in the state
Streamlined Public Health Follow-Up

- Convened LHD working group to discuss
- Reduced information collected during investigations
- Less case/contact management if not high-risk or in high-risk occupation/setting
  - ‘High-risk’ includes infants <1 year, pregnant women in 3rd trimester, contacts/caregivers to either
  - No 2 week follow-up calls; use of CDPH ‘Suspect’ case definition; prioritize PEP for high-risk persons/settings
  - Recommendations for exposed healthcare workers
- Less intervention in K-12 school settings
  - Few high-risk persons; nearly all cases vaccinated; unclear how effective interventions are when disease widespread in community
  - Consideration of readmission after 3 days of treatment
How does 2014 compare to 2010?

• Will likely have similar # of cases reported
• More disease in older adolescents/teens
  ▪ Consistent with cohort receiving DTaP vaccines
  ▪ High school outbreaks common in 2014
• Less disease in young infants
• Fewer hospitalizations and deaths
  ▪ Hospitalizations: 288 in 2014 vs. 808 in 2010
  ▪ Deaths: 1 in 2014 vs. 10 in 2010
• May suggest an impact from vaccination of pregnant and postpartum women
Incidence of reported pediatric pertussis cases by age – California, 2010 and 2014*

*Reported to CDPH as of 9/15/2014
Infant pertussis cases <12 months of age -- California, 2010 and 2014*

*reported to CDPH as of 9/15/2014
What can we learn from baboons?

- Thought to be a good model for pertussis disease in humans\(^1\); several recent (but very small n) studies may provide insight

- Baboons challenged with *B. pertussis* after completion of the acellular pertussis vaccine series did not have pertussis symptoms but were still colonized with bacteria and able to transmit to close contacts\(^2\)

- Infant baboons born to mothers that received acellular pertussis vaccine during 3\(^{rd}\) trimester were protected against pertussis disease at 5-6 weeks of age (but were still colonized with bacteria)\(^3\)

What about additional doses of Tdap?

- Safe and provide short-term immunity
- Only currently recommended for pregnant women
  - Not considered cost-effective on a population level due to short duration of immunity
  - Limited/no data on effectiveness of Tdap for “cocooning” – may be beneficial on an individual basis, but no longer seen as a public health priority
  - ACIP will discuss recommendations for healthcare workers at the October 2014 meeting
- Highest burden of disease is in adolescents and teens; very few have known complications
  - <1% hospitalized among 10-17 age group
- Repeated doses of Tdap doses can be given and would likely provide short-term protection
  - May not be covered by insurance
Conclusions

• Increased incidence is the new normal of pertussis
• No new vaccines currently in the pipeline
• Returning to use of whole cell vaccine unlikely unless it can be modified to be less reactogenic
• Prevention efforts should be targeted at preventing infection, severe disease, and death in young infants
• Educational materials/communications should be targeted towards healthcare providers, especially prenatal care providers, who can most influence patients
• It’s important to note that even with its limitations, acellular vaccines greatly reduce the incidence of pertussis; in the prevaccine era the incidence of pertussis was six times higher than in the 2010 epidemic
CDPH materials

- CDPH Pertussis Case Report Form:

- CDPH Pertussis ‘Quicksheet’:

- Pertussis educational materials:
  http://eziz.org/resources/pertussis-promo-materials/