Preventing Perinatal Pertussis and Pertussis in Pregnancy

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Riverside University HEALTH SYSTEM
Public Health

v1.0

The Point of this Presentation*

*Learning Objectives

- Update providers and clinical staff on current guidelines regarding screening, testing, reporting and clinical management of infant pertussis.
- Provide American College of Obstetricians and Gynecologists (ACOG), Centers for Disease Control (CDC) and the California Department of Public Health (CDPH) recommendations for the Tdap vaccine and pregnancy.
- Update providers and clinical staff on the CDC pertussis vaccination guidelines and the effectiveness of using the pertussis vaccine as a tool to prevent death in infants.
- Gratuitously use the letter P in all the slide titles.

Perfunctory Palaver*

*Disclosures and Disclaimers

- The speaker has no financial relationship with any of the products discussed, nor has received any remuneration or honorarium for this presentation.
- Although the recommendations in this presentation are based on the most current CDC/ACIP, CDPH and ACOG guidelines at the time of writing, they are not responsible for the content of this presentation, nor should the use of their guidelines constitute any endorsement by those organizations.
- Recommendations made in this presentation should not replace expert consultation when appropriate or necessary in any clinical case.
- However, speaker did buy a new thesaurus to come up with all those “P” words.

The Population Peril of Pertussis

- Pertussis continues to be a major problem throughout the United States.
- 48,277 national cases were reported at peak in 2012.

Riverside	2014	2015	2016	2017
	461	135	82	**147**
	20.3 *per 100k*	3.2 *per 100k*	3.5 *per 100k*	**6.2** *per 100k*

California	2014	2015	2016	2017
	11205	4706	1938	**2925**
	29.3 *per 100k*	12.0 *per 100k*	4.9 *per 100k*	**7.4** *per 100k*

San Bernardino	2014	2015	2016	2017
	206	91	32	45
	-	-	1.5 *per 100k*	**2.1** *per 100k*

CDPH Pertussis Status Reports through 2018; Riverside County Communicable Disease Report (2016)

Pointing out the Perp*

*Causative Organism

- The three major *Bordetella* species relevant to human disease are *B pertussis, B parapertussis* and *B bronchiseptica*.
  - *B pertussis*: whooping cough “proper”; **pertussis toxin** is the key virulence factor
  - *B parapertussis*
    - Does not produce pertussis toxin; thus **no lymphocytosis** and a **shorter and milder disease except** when co-infected with *B pertussis* (in which case the clinical presentation is **worse**)
    - Long-lasting immunity, but does not extend to pertussis, and pertussis vaccination does not protect against parapertussis
  - *B bronchiseptica*
    - Mostly of issue for animals (particularly dogs – important cause of **kennel cough**), but can cause pertussis-like disease in humans
    - Does not produce PT either, does not induce cross-immunity
    - **Resistant to macrolides**, making treatment more complicated

Bolding, Kamat. *Whooping cough caused by* B parapertussis. Infect Med 2004;21(6).

CDC, *Pertussis (Whooping Cough), Clinical Features.* cdc.gov

Catarrhal

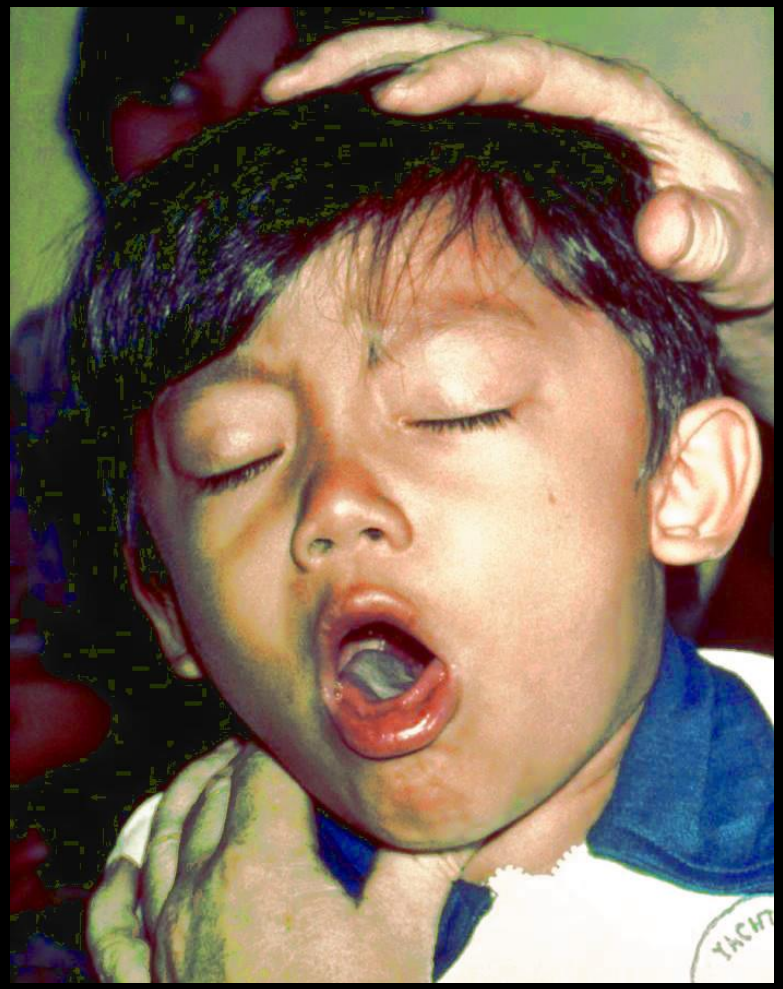
Coryza, mild fever	Incubation 5-10 days	Duration 4-21 days, median 7-10

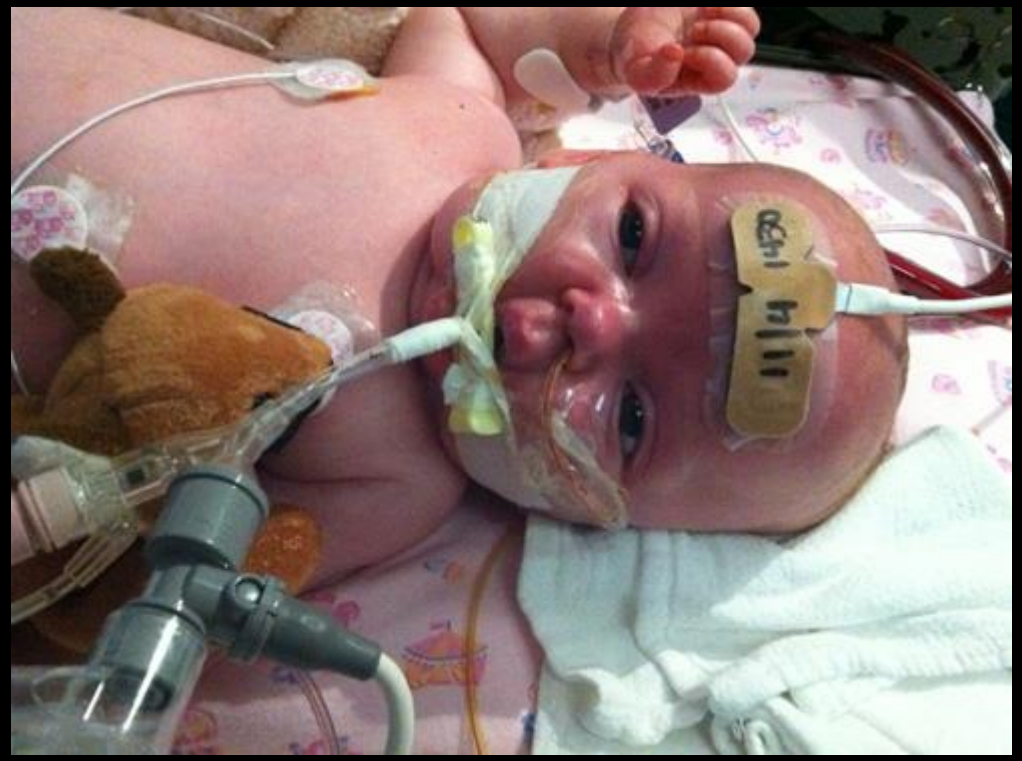
Paroxysmal

Severe cough with inspiratory whoop	Up to 10 week duration, median 1-6 weeks	Progressive up to 3 weeks	Night worsening

Convalescent

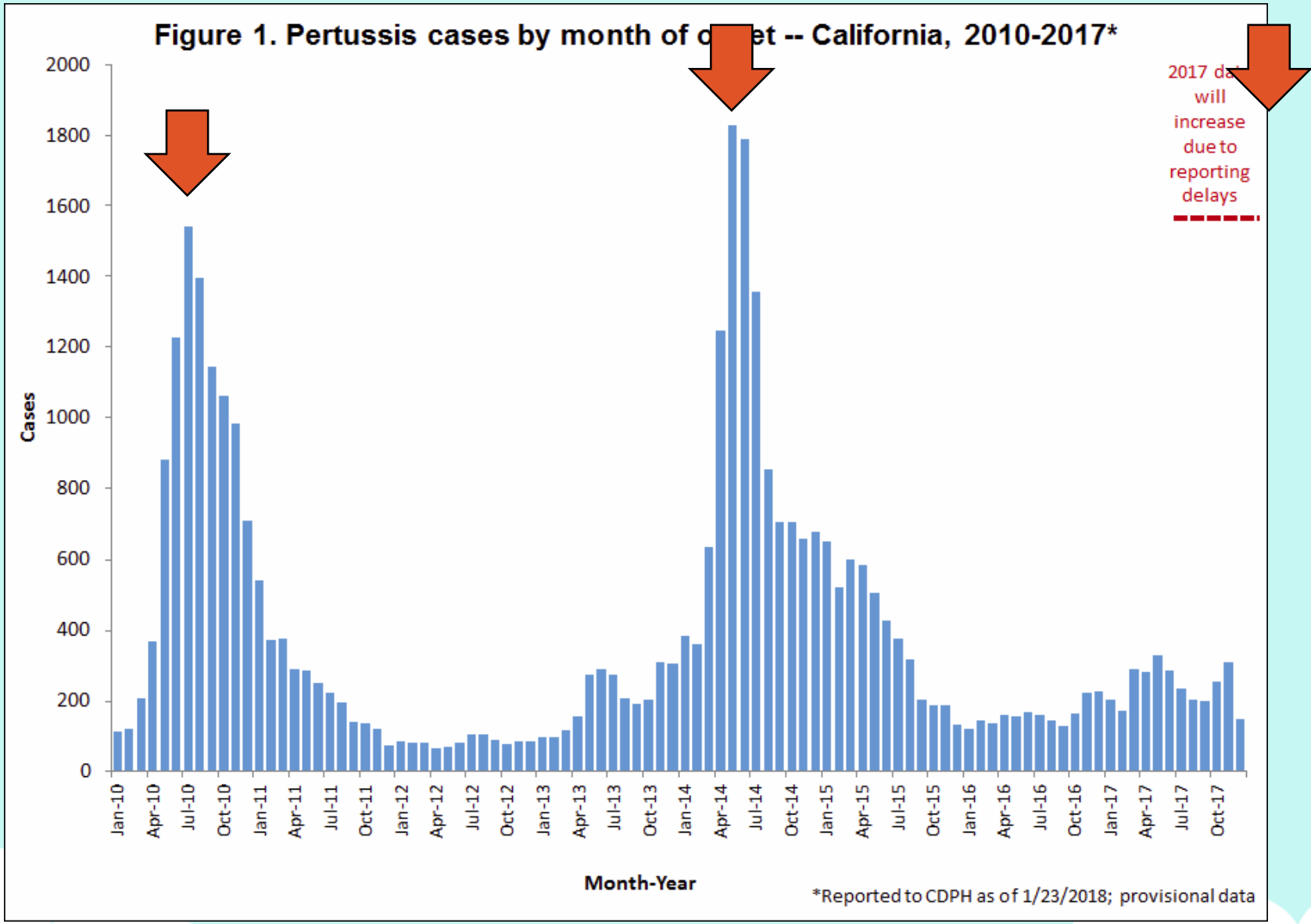
Gradual recovery	Less severe cough may last up to three weeks	Paroxysms may reappear with subsequent illnesses





Problematic Periodicity

- Immunity to pertussis is not lifelong:
  - 4-20 years for cases
  - 4-12 years **(3-4 years average)** after 5 doses of DTaP/Tdap
- Recurrent “natural” cycle roughly q4 years as individuals become vulnerable



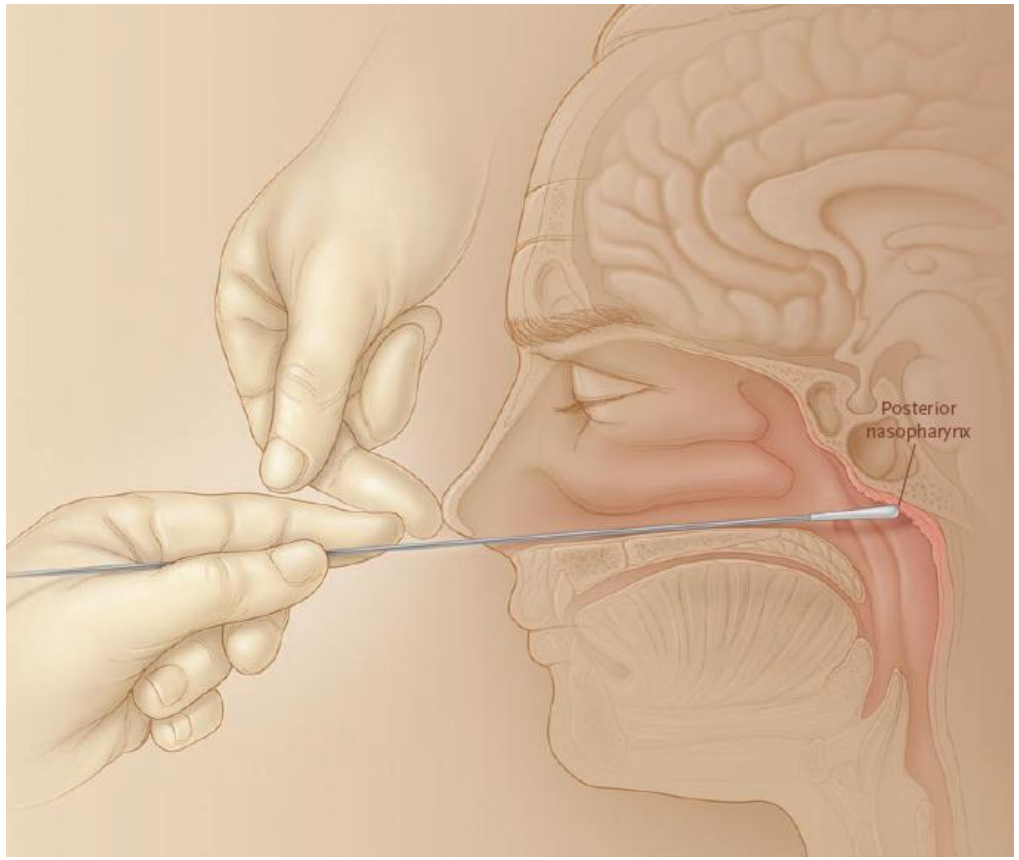
California Department of Public Health 2017; Wendelboe *Ped Infect Dis* 2005 May 24(5); McGirr *Pediatrics* 2015 Feb 135(2).

Priority Patients for Probing and Prophylaxis*

*Screening and Diagnostic Guidelines

- **Prophylaxis is available.** If pertussis is detected in a household, consider testing for pertussis in other symptomatic individuals, and consider prophylactic options (to be discussed shortly).
- **Have a low threshold** for testing if an infant is in the home. Symptomatology may not be reliable:
  - Atypical presentations in very young infants <12mo are dangerously common. Apnea or posttussive emesis may be the only symptom(s).
  - Even in vulnerable patients, the initial 7-10 day **catarrhal** stage may be difficult to distinguish from URIs or influenza.
  - The **paroxysmal** phase may be abbreviated or much less severe in adults and currently immunized children and adolescents.
- However, **testing asymptomatic individuals or contacts is not recommended.**

CDC, *Pertussis (Whooping Cough), Clinical Features; Best Practices … on PCR for Diagnosing Pertussis.* cdc.gov



Proper Positioning to Poke the Posterior Nasopharynx*

*without Perforating It

- Pass along the floor of the nasal cavity to the posterior NP, wait 15-30 sec, then rotate and remove
- Dacron®, rayon, nylon or calcium alginate swabs **only**
- Calcium alginate cannot be used for PCR testing

Figure from Mertsola, He. *Bordetella pertussis*. antimicrobe.org

Procedural Possibilities for Prognostication*

*Diagnostic Modalities

- Culture testing
  - Pros
    - **Excellent specificity** (approaches 100%, considered “gold standard”)
    - **Most useful in unvaccinated infants**, who are also those most at risk of complications
    - May use any swab type, though calcium alginate preferred. **No cotton swabs.**
  - Cons
    - **Low sensitivity** (under 50% in some studies)
    - Much less useful after any antibiotic treatment or two weeks of cough
    - Must be plated within 24 hours
    - **7-10 days** required for results

CDC, *Pertussis (Whooping Cough), Diagnosis Confirmation.* cdc.gov

Procedural Possibilities for Prognostication*

*Diagnostic Modalities

- Direct fluorescent antibody (DFA)
  - Pros
    - Theoretical high specificity (>90% under optimal conditions)
    - **Fastest** screen (results in hours)
  - Cons
    - May be even **less sensitive than culture** (10-50%) (MMWR 2006)
    - **Labour-intensive** (stained and studied under microscopy)
    - **Results vary** due to operator and technique
    - **No longer recommended for routine screening**, and positive DFA results without other testing should be considered probable, not confirmed (CDC Surveillance Manual on Pertussis).

Loeffelholz et al. *Comparison of PCR, culture and DFA testing for detection of B. pertussis*. J Clin Microbiol 1999 Sep 37(9).

Procedural Possibilities for Prognostication*

*Diagnostic Modalities

- Pertussis serology (IgG-PT)
  - Pros
    - Least sensitive to timing factors (**optimal timing 2-8 weeks after onset of cough**, but as late as 12 weeks). In the absence of recent immunization, increasing titer or a single IgG level to pertussis toxin of 100 IU/mL or higher is suggestive of infection.
    - **Doesn't require reaming out baby boogers.** Huge plus in snotty infants.
  - Cons
    - Primarily **retrospective. Not recommended for routine screening.**
    - Performance characteristics vary based on lab (these numbers are based on the **CDC single point serology test**)
    - IgG only. The CDC single point serology test is not widely available and no test is considered confirmatory. Current IgA/IgM assays lack sufficient sensitivity and specificity.

CDC, *Pertussis (Whooping Cough), Diagnosis Confirmation.* cdc.gov; presenter's personal clinical impressions

Procedural Possibilities for Prognostication*

*Diagnostic Modalities

- Polymerase chain reaction (PCR)
  - Pros
    - Very fast, results available in as little as 8-24 hours. Not affected by recent immunization.
    - Optimal sensitivity in **first three weeks**
  - Cons
    - Sensitivity drops rapidly after week 4 **or** five days of antibiotics
    - **No cotton or calcium alginate swabs**
    - **False positives** possible through contamination (use single-use gloves and semi-solid media for transport)
    - Performance characteristics can vary widely from lab to lab
    - **Culture confirmation still recommended** by CDC

CDC, *Surveillance Manual, Vaccine Preventable Diseases, Pertussis*: cdc.gov

Physic and Prevention*

*Treatment and Prophylaxis

- **Early treatment is vital.** Treatment within the first 1-2 weeks can dramatically reduce symptoms and total duration of illness.
  - Treat persons >1y/o within **three weeks** of cough onset.
  - Treat persons <1y/o **and pregnant women** within **six weeks** of cough onset.
- The **infectious period** extends from the **beginning of the catarrhal stage** through the **third week of the paroxysmal stage** or **five days** after effective **antibiotic treatment**.
  - **Prophylaxis** should be started for close contacts **within 3 weeks of exposure.**
- If clinical testing is delayed and suspicion is high, ***don't wait for results!***

CDC, *Pertussis (Whooping Cough), Treatment.* cdc.gov

Physic and Prevention*

*Treatment and Prophylaxis

- Macrolide class **(treatment of choice)**
  - **Same regimens for treatment *and* prophylaxis/PEP**
  - Erythromycin, clarithromycin or azithromycin?
    - **Infants < 1 y/o: prefer azithromycin** (no association with infantile hypertrophic pyloric stenosis as with erythromycin; more data than clarithromycin)
    - Others: select on basis of cost, adherence and adverse effects (GI intolerance, hypersensitivity, QT prolongation). **Azithromycin is quickest.**
  - Azithromycin: 10mg/kg/d x 5d (adults: Z-Pak, i.e., 500mg day 1)
  - Erythromycin: 40-50mg/kg/d divided q6h x 14d (adults: 2g div q6h x 14d)
  - Clarithromycin: 15mg/kg/d divided bid x 7d (adults: 1g div bid x 7d)

CDC, *Pertussis (Whooping Cough), Treatment.* cdc.gov; MMWR Recommendations & Reports 2005(12) 54(RR14);1-16.

Physic and Prevention*

*Treatment and Prophylaxis

- TMP-SMX (alternative)
  - **Same regimens for treatment *and* prophylaxis/PEP**
  - Use in 2mo+ (risk of kernicterus in younger) when:
    - Hypersensitivity or allergy to macrolide class
    - Unacceptable side effects (GI intolerances or *torsades de pointes* with erythromycin)
    - Involvement of macrolide-resistant strain (mercifully rare)
  - 2mo-adult: TMP 8mg/kg/d SMX 40mg/kg/d div bid x 14d
  - Adult: TMP-SMX (Bactrim DS equivalent) 160/400mg po bid x 14d

CDC, *Pertussis (Whooping Cough), Treatment.* cdc.gov; MMWR Recommendations & Reports 2005(12) 54(RR14);1-16.

Pertussis Protection Provided Percutaneously*

*Immunization Recommendations

- The best prevention is primary prevention: **vaccinate!**

Get your flu shot too. Don’t make Nurse Weller come over there.

Vaccine	Birth	1 mo	2 mos	4 mos	6 mos	9 mos	12 mos	15 mos	18 mos	19-23 mos	2-3 yrs	4-6 yrs	7-10 yrs	11-12 yrs	13-15 yrs	16 yrs	17-18 yrs
Hepatitis B[1] (HepB)	1st dose	←2nd dose→			←3rd dose→												
Rotavirus[2] (RV) RV1 (2-dose series); RV5 (3-dose series)			1st dose	2nd dose	See footnote 2												
Diphtheria, tetanus, & acellular pertussis[3] (DTaP: <7 yrs)			1st dose	2nd dose	3rd dose		←4th dose→					5th dose					
Haemophilus influenzae type b[4] (Hib)			1st dose	2nd dose	See footnote 4		←3rd or 4th dose, See footnote 4→										
Pneumococcal conjugate[5] (PCV13)			1st dose	2nd dose	3rd dose		←4th dose→										
Inactivated poliovirus[6] (IPV: <18 yrs)			1st dose	2nd dose	←3rd dose→							4th dose					
Influenza[7] (IIV)					←Annual vaccination (IIV) 1 or 2 doses→									Annual vaccination (IIV) 1 dose only			
Measles, mumps, rubella[8] (MMR)					See footnote 8		←1st dose→					2nd dose					
Varicella[9] (VAR)							←1st dose→					2nd dose					
Hepatitis A[10] (HepA)							←2-dose series, See footnote 10→										
Meningococcal[11] (MenACWY-D ≥9 mos; MenACWY-CRM ≥2 mos)			←See footnote 11→											1st dose		2nd dose	
Tetanus, diphtheria, & acellular pertussis[13] (Tdap: ≥7 yrs)														Tdap			
Human papillomavirus[14] (HPV)														←See footnote 14→			
Meningococcal B[12]														←See footnote 12→			
Pneumococcal polysaccharide[5] (PPSV23)											←See footnote 5→						

ACIP 2018

Range of recommended ages for all children

Range of recommended ages for catch-up immunization

Range of recommended ages for certain high-risk groups

Range of recommended ages for non-high-risk groups that may receive vaccine, subject to individual clinical decision making

No recommendation

Percutaneous Protection for Pertussis*

*More Sticking Needles into People

- Pediatric immunization recommendations
  - Primary series at 2mo 4mo 6mo 15-18mo 4-6yo, Tdap booster at age 11-12yo
  - Minimum interval for dose 1-2 and dose 2-3 is 4 weeks
  - Minimum interval for dose 3-4 is 6 months; **dose 4 minimum age is 12 months**
  - Minimum interval for dose 4-5 is 6 months; **dose 5 minimum age is 4 years**
  - **Age 7+ with incomplete DTaP history**: use Tdap as the first dose in the catchup series with Td after. Okay to give Tdap booster at 11 y/o regardless.
  - **There is no need to restart the series** if any prior doses were administered.

Percutaneous Protection for Pertussis*

*More Sticking Needles into People

- Adult immunization recommendations
  - Catch up on any deficiencies. Adults should have three doses (Tdap, Td/Tdap @ 4wks, Td/Tdap @ 6mo). **There is no need to restart the series** if any prior doses were administered.
  - **If Tdap has never been administered before and individual is due** (last Td >= 10 years ago), **administer 1 dose of Tdap**, and Td boosters q10y thereafter.
  - If Tdap history is unknown, ensure they receive at least one dose.
  - Tdap is OK for wound management if a tetanus booster is recommended.
  - Administer Tdap as soon as 2 years after last Td if never administered for:
    - HCWs
    - Local pertussis outbreak
    - **Adult close contacts of a child under 12 months of age**

CDC-ACIP. *Preventing Tetanus, Diphtheria and Pertussis Among Adults.* MMWR 2006(12); 55(RR17);1-33; revised 2018 by ACIP.

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20th CENTURY FOX

Percutaneous Protection in Pregnancy*

*Because Pregnancy Isn't Fun Enough Without Shots

- Immunization recommendations during pregnancy
  - OB providers are **encouraged to stock and administer** Tdap in their offices!
  - Optimal administration at **27-36 weeks gestation** (earlier the better), but may be given any time
    - If vaccinated early, **no need to revaccinate** again during that pregnancy.
    - Wound management and outbreaks may necessitate earlier administration.
  - Administer one dose of Tdap during **each pregnancy**, or immediately postpartum if no prior dose of Tdap had ever been administered.
  - A pregnant woman with unknown or incomplete tetanus immunization history should complete three doses as any other adult.
  - **No evidence of adverse fetal effects has been demonstrated.**
  - **Family members and caregivers** ideally should be current at least 2 weeks prior to contact with the newborn.

ACIP 2018, ACOG Committee Opinion #718 (9/2017)

Points to Ponder*

*Future Considerations in Pertussis Control

- DTaP vs DPT/DTwP
  - The US switched to acellular pertussis in the 1990s due to safety concerns.
  - Teens who received DTaP had a 6x greater risk of contracting pertussis than DTwP in a 2010-11 outbreak; this was not overcome with Tdap (AAP *Pediatrics* June 2013). wP preparations may last 3x as long (Birkebaek 2009).
  - Are the antigens in DTaP/Tdap sufficient for long-lasting immunity?
- Repeated Tdap administration in adults
  - Tdap is licensed for one-time administration only (pregnancy excepted).
  - Although safe, ACIP indicates they do not believe multiple Tdap administration to be cost-effective (ACIP 2012), but this may be confounded by many adults having received wP. A second Tdap booster at 16/21yo lasts about as long as the first.
  - Do we need to reevaluate it as a greater proportion of adults have had only aP?

Pidamaya yedo!*

***Thank you!* in the Dakota language of the upper Midwest**

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