An Update on Pediatric Vaccines

Rhya Strifling, MD FAAP
Assistant Professor
Division of General Pediatrics
University of Kentucky

Faculty Disclosure

- I have not had any relevant financial relationships with resulting commercial interests or conflicts of interest in the past 12 months.

Educational Need

- Vaccination development and scheduling is an ever evolving process
- Yearly updates in vaccination recommendations by the Advisory Committee on Immunization Practices
- Important for practitioners to be aware of these updates
- Important for practitioners to know where to find the resources containing this information

Learning Objectives

- Cite some of the most recent updates in the immunization schedule for persons aged 0 through 18 years
- Describe the resources that will help in day-to-day routine and catch-up immunization administration
- Explain to your patients the importance of vaccination
- Review the AAP report that addresses vaccine hesitancy

Expected Outcome

- Better immunization rates
- Vaccination at appropriate time intervals

Recommended Immunization Schedules for Persons Aged 0 Through 18 Years
United States 2016

- Approved by the Advisory Committee on Immunization Practices (ACIP), the American Academy of Pediatrics (AAP), and the American Academy of Family Physicians (AAFP)
- Use all 3 schedules (Figures 1, 2, and 3) and their respective footnotes together, not separately
Any dose not administered at the recommended age should be administered at a subsequent visit, when indicated and feasible.

The use of a combination vaccine generally is preferred over separate injections of its equivalent component vaccines.

Clinically significant adverse events that follow vaccination should be reported to the Vaccine Adverse Event Reporting System (VAERS) online (http://www.vaers.hhs.gov) or by telephone (800-822-7967).

**Important Footnotes**

1. Hepatitis B vaccine and HepB Immune Globulin (HBIG)
2. Hepatitis B vaccine
3. HepB Immune Globulin (HBIG)
4. Nothing until the mother's lab results are known

*If a mother's HBsAg status is unknown and her infant weighs >2,000 grams, what needs to be administered within the first 12 hours of life?*

1. Hepatitis B vaccine and HepB Immune Globulin (HBIG)
2. Hepatitis B vaccine
3. HepB Immune Globulin (HBIG)
4. Nothing until the mother’s lab results are known

**Hepatitis B Vaccine**

*If mother’s HBsAg status is unknown:*

1. within 12 hours of birth administer HepB vaccine for infants weighing ≥2,000 grams
2. HepB vaccine plus HBIG for infants weighing <2,000 grams
3. Determine mother’s HBsAg status as soon as possible and, if she is HBsAg-positive, administer HBIG for infants weighing ≥2,000 grams (no later than age 1 week).

**Hepatitis B Vaccine**

*For infants born to hepatitis B positive mothers:*

1. Administer HepB vaccine and hepatitis B immune globulin (HBIG) within 12 hours of birth
2. These infants should be tested for HBsAg and antibody to HBsAg (anti-HBs) at age 9 through 18 months, or 1 to 2 months after completion of at least 3 doses of the HepB series if the series is delayed
3. The CDC recently recommended testing occur at age 9 through 12 months
4. For infants born to hepatitis B negative mothers:
   - Administer monovalent HepB vaccine to all newborns before hospital discharge

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“Give Birth to the End of Hep B”

- Campaign led by the Immunization Action Coalition to prevent perinatal transmission of Hepatitis B
- 1 in 3 newborns leave the hospital without the birth dose of Hep B, which leads to ~800 infants a year to be chronically infected through perinatal exposure

Why should we give the Hep B vaccine to all newborns?

- It prevents mother-to-infant transmission
  - prevents 70%-95% of transmission to infants born to HBsAg-positive women
- It prevents household transmission
  - protects infants from infected family members and other caregivers
- It provides protection if medical errors occur
  - Provides a safety net to prevent perinatal transmission when medical errors occur

Safety net for medical errors

- Ordering the wrong hepatitis B screening test
- Misinterpreting or mistranscribing hepatitis B test results
- Failing to communicate results to or within the hospital
- Not giving hepatitis B vaccine to infants born to mothers of unknown HBsAg status within 12 hours of birth
- Not giving prophylaxis to an infant even when the mother’s HBsAg-positive status is documented

Hepatitis B Vaccine

- Doses after the birth dose:
  - Administration of a total of 4 doses of HepB vaccine is permissible when a combination vaccine containing HepB is administered after the birth dose.
  - The minimum interval between dose 1 and dose 2 is 4 weeks, and between dose 2 and 3 is 8 weeks. The final (third or fourth) dose in the HepB vaccine series should be administered no earlier than age 24 weeks and at least 16 weeks after the first dose.

Rotavirus Vaccine

- The maximum age for the first dose in the series is 14 weeks, 6 days; and
- 8 months, 0 days for the final dose in the series.
- Vaccination should not be initiated for infants aged 15 weeks, 0 days or older.

In the News...

Children Treated in ED or Hospitalized for Rotavirus Gastroenteritis
In the News...

• Before the introduction of rotavirus vaccine, between 55,000 and 70,000 children were hospitalized each year in the US
• And >400,000 children with outpatient visits due to rotavirus-related disease
• Post-vaccine national rates have declined by 58-90%

Diphtheria and Tetanus Toxoids and acellular Pertussis Vaccine (DTaP)

• Inadvertent early administration of the 4th dose of DTaP: If the 4th dose was administered at least 4 months, but less than 6 months, after the 3rd dose of DTaP, it need not be repeated.
• The 5th dose of DTaP vaccine is not necessary if the 4th dose was administered at age 4 years or older.

Haemophilus influenzae type b (Hib) conjugate Vaccine

• New footnote gives guidelines of vaccination of persons with high-risk conditions:
  • Chemotherapy recipients
  • Anatomic/functional asplenia
  • HIV
  • Immunoglobulin deficiency
  • Early component complement
  • Stem cell transplant recipient
  • Elective splenectomy
• Hib vaccine should be administered to unvaccinated persons aged 5 years or older who have anatomic/functional asplenia (including sickle cell disease) and human immunodeficiency virus (HIV) infection

Pneumococcal Conjugate Vaccine (PCV13)

• Available since March 2010
• Administer 1 dose of PCV13 to all healthy children aged 24 through 59 months who are not completely vaccinated for their age
• Not usually recommended for healthy children age 5 years and older

Pneumococcal Polysaccharide Vaccine (PPSV23)

• Administer PCV 13 and PPSV23 to children aged 2 years or older with certain underlying high-risk medical conditions, including a cochlear implant.
• PPSV23 should be given at least 8 weeks after the most recent PCV13 dose
• A single revaccination with PPSV23 should be administered 5 years after the first dose
**Inactivated Poliovirus Vaccine (IPV)**

- The final dose in the series should be administered on or after the 4th birthday and at least 6 months after the previous dose.
- If both OPV and IPV were administered as part of a series, a total of 4 doses should be administered, regardless of the child's current age.
- IPV is not routinely recommended for U.S. residents aged 18 years or older.

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**In the News (2012)…**

- January 13, 2012: India reached a historic milestone: 12 months without a single case of polio!
- Last case in 2011 was a 2-year-old girl from Howrah District, West Bengal, a community with elevated vaccine refusal rates.
- "Pulse Polio Immunisation Programme"- since 1995.
- Annual incidence of polio has decreased from 150,000 cases in 1985 to 6,028 cases in 1991 to 741 cases in 2009 to only 42 cases in 2010.


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**In the News (2016)…**

- More than 2.5 billion children have received polio vaccinations since the Global Polio Eradication Initiative was started in 1988.
- The Americas, Europe, the Western Pacific and South East Asia are free of circulating poliovirus.
- Wild Poliovirus (WPV) type 2 was declared globally eradicated in September 2015.
- April 17, 2016- 155 countries participated in a synchronized global switchover from trivalent to bivalent OPV (removing WPV 2).
- WPV type 3 has not been detected since 2012.

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**In the News…**

- Transmission in Nigeria and the African Region was interrupted in 2014 (Aug). However, in September 2016, 3 children in the Borno state of Nigeria were infected with WPV type 1.
- Paralytic polio caused by circulating vaccine-derived poliovirus (cVDPV) was only reported in 7 countries in 2016.
- Transmission of WPV in 2016 has been limited to 17 cases in Afghanistan and Pakistan, as of July 6.
- Interruption of WPV 1 in these last 2 countries is the goal for 2016, but is very dangerous.

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*Anaphylaxis to eggs is a contraindication to receiving the flu vaccine.*

1. True
2. **False**
2016-2017 Influenza Vaccine

• New composition this season:
  • Trivalent vaccine:
    • A/California/7/2009 (H1N1)-like virus (same)
    • A/Hong Kong/4801/2014 (H3N2)-like virus (different)
    • B/Brisbane/60/2008-like virus (different)
  • Quadrivalent vaccine:
    • Same as above +
    • B/Phuket/3073/2013-like virus

In the News...

• In June of 2016, the CDC and ACIP recommended that the live attenuated influenza vaccine NOT be used in the 2016-2017 flu season
• Studies from the last three flu seasons have shown that the live vaccine (Flumist) has not been effective in protecting patients from getting the flu

2016-2017 Influenza Vaccine Recommendations

• Annual universal influenza immunization is indicated for ALL children and adolescents 6 months of age and older
• All health care personnel, all household contacts of children, all child care providers, and all pregnant women should receive an annual influenza vaccine
• Children 8 years and under who are receiving the vaccine for the first time should receive a second dose this season at least four weeks after the first dose
• Children 9 years and older need only 1 dose

2016-17 Influenza Vaccine Dosing Algorithm for Children 6 months to 8 years of age

Number of Seasonal Influenza Doses for Children 6 Months Through 8 Years of Age

Has child received 2 or more total doses of any trivalent or quadrivalent vaccine prior to July 1, 2016?

Yes

1 Dose

No/Don’t know

2 Doses (prefer 4 months)

2016-2017 Influenza Vaccine Recommendations

• Children aged 6 months through 8 years need only 1 dose of vaccine in 2016–2017 if they have received the following:
  – 2 or more doses* of any trivalent or quadrivalent vaccine prior to July 1, 2016
• *The 2 doses need not have been received during the same season or consecutive seasons.

Which vaccine is now recommended for children who are traveling internationally between the age of 6 and 11 months?

1. Varicella
2. MMR
3. Hepatitis A
4. Tdap
### Measles, Mumps, and Rubella (MMR) Vaccine

- Administer MMR vaccine to infants aged 6 through 11 months who are traveling internationally.
- These children should be revaccinated with 2 doses of MMR vaccine, the first at ages 12 through 15 months and at least 4 weeks after the previous dose, and the second at ages 4 through 6 years.

### MMR Vaccine

- Administer 2 doses of MMR vaccine to children aged 12 months and older before departure from the US for international travel.
- The first dose should be administered on or after age 12 months and the second dose at least 4 weeks later.
- One dose of MMR vaccine is about 78% effective in disease prevention, while 2 doses are ~88% effective.

### In the News...

- Measles cases in the United States hit a 20-year high in 2014.
- 667 cases of measles from 27 states in the US.
- This is the largest number of measles cases in the United States reported since measles elimination was documented in the U.S. in 2000.
- Many of the measles cases that year were associated with international travel (to/from the Philippines) by unvaccinated people.
- Ninety percent of all measles cases in the US were in people who were not vaccinated or whose vaccination status was unknown (383 Amish cases).
- In 2015, 189 cases from 24 states (Disneyland in CA).
- In 2016 so far, 54 cases from 16 states.

### In the AAP News...

- 186,000 cases of mumps per year in the pre-vaccine era.
- Numbers have decreased by 99% since the introduction of the mumps vaccine.
- In 2015, 1,050 cases of mumps were reported with outbreaks still occurring in highly vaccinated areas.
- High vaccination rates help to limit the size, duration, and spread of an outbreak.

### Hepatitis A Vaccine

- Administer the second (final) dose 6 to 18 months after the first.
- Unvaccinated children 24 months and older at high risk should be vaccinated.
- A 2-dose HepA vaccine series is recommended for anyone aged 24 months and older, previously unvaccinated, for whom immunity against hepatitis A virus infection is desired.

### Hepatitis A Vaccine

- Hepatitis A rates in the United States have declined by 95% since Hepatitis A vaccine first became available in 1995.

![Incidence of hepatitis A, by year: United States, 1980-2014](image)
### In the News...

- "Improved Hepatitis A vaccination coverage urged for adolescents"—Christina Dorell, MD, MPH and colleagues from the CDC, (*Dorell CG. Pediatrics*. 2012)
- 2009 National Immunization Teen Survey showed:
  - 42% of 13-17-year-olds had received Hep A
  - 70% of those completed a 2-dose series
- Hep A infection in teens and adults can be severe and can last up to 2 months
- High risk behaviors + international travel put many adolescents at increased risk

### Meningococcal Conjugate Vaccines

**New Footnote:** Vaccination of persons with high-risk conditions and other persons at increased risk of disease:
- 1) Children with anatomic or functional asplenia (including sickle cell disease)
- 2) Children with persistent complement component deficiency
- 2) For children who are residents of or travelers to countries with hyperendemic or epidemic disease, including in the African meningitis belt or the Hajj
- 3) For children who are present during community outbreaks caused by a vaccine serogroup

### Meningococcal Conjugate Vaccines

- Menactra (MenACWY-D, 9 months minimum)
- Menveo (MenACWY-CRM, 2 months minimum)
- MenHibrix (Hib-MenCY, 6 weeks minimum)
- MenB
  - Bexsero (MenB-4C, 10 years minimum)
  - Trumenba (MenB-FHbp, 10 years minimum)

### A 15 yo female receives her first MCV4 vaccine in your office today. When will she need a booster dose?

1. In five years
2. No booster dose is needed
3. Between the age of 16 and 18 years

### Meningococcal Conjugate Vaccines

- Administer MCV4 at age 11 through 12 years with a booster dose at age 16 years.
- Catch-up
  - Administer MCV4 at age 13 through 18 years if patient is not previously vaccinated.
  - If the first dose is administered at age 13 through 15 years, a booster dose should be administered at age 16 through 18 years with a minimum interval of at least 8 weeks after the preceding dose.
  - If the first dose is administered at age 16 years or older, a booster dose is not needed.

### Meningococcal B Vaccines

- Bexsero (MenB-4C)
  - 2 dose series at least 1 month apart
- Trumenba (MenB-FHbp)
  - 3 dose series with the second dose at least 2 months after the first and then the third dose at least 6 months after the first
**Meningococcal B Vaccines**

- The AAP and CDC recommend routine MenB vaccination for those 10 and older who are at increased risk of MenB, including those with persistent complement component deficiencies, anatomic or functional asplenia, and people living in an outbreak area.
- Permissive recommendation for those not at increased risk of Men B disease.

**Meningococcal B Vaccines**

- Clinical Discretion:
  - Young adults aged 16-23 years (preferred 16-18 years) may be vaccinated with either Bexsero or Trumenba vaccine to provide short-term protection against most strains of serogroup B meningococcal disease.
  - The two MenB vaccines are not interchangeable; the same vaccine product must be used for all doses.

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**Tetanus and Tdap Vaccines**

- An 11 yo male is in your office today for his 6th grade physical and vaccines. He received a Td booster in the ER 8 weeks ago after he stepped on a nail. Should you offer the Tdap vaccine to him today as part of his routine vaccines?

1. Yes, offer the Tdap vaccine today.
2. No, there needs to be at least a 6 month interval between the tetanus and diphtheria toxoid-containing vaccines.

**Tetanus and Tdap Vaccines**

- Tdap vaccine can be administered regardless of the interval since the last tetanus and diphtheria toxoid–containing vaccine.

**Tetanus and Tdap Vaccines**

- Minimum age: 10 years for both Boostrix and Adacel.
- Persons aged 11 through 18 years who have not received Tdap vaccine should receive a dose followed by tetanus and diphtheria toxoids (Td) booster doses every 10 years thereafter.
- Tdap vaccine should be substituted for a single dose of Td in the catchup series for children aged 7 through 10 years.

**Tdap and Pertussis**

- Administration 1 dose of Tdap vaccine to pregnant adolescents during each pregnancy (preferred during 27 through 36 weeks GA) regardless of time since prior Td or Tdap vaccination.
- New research has been reviewed regarding the safety of Tdap vaccination during pregnancy.
- “Studies of over 50,000 women receiving Tdap during pregnancy show no increased risk of adverse maternal or infant health outcomes”—Jennifer Liang, DVM, MPVM -- CDC epidemiologist.
**Pertussis**

- 32,971 cases of pertussis were reported in 2014
- 28,639 cases reported during 2013
- 48,277 cases of pertussis were reported to CDC in 2012, including 20 pertussis-related deaths
- In 2010, >27,000 cases were reported nationally, with 27 deaths (25 in infants)
- Highest risk age groups seem to be <3 months and 13-16 years old
- Concerted efforts needed for vaccinating those who are around infants, such as pregnant women, family members, and caregivers
- Teen booster is key as protection seems to be waning over time

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**HPV Types**

- HPV types 16, 18, 31, 33, 45, 52, and 58 are responsible for:
  - 90% cervical cancer
  - 90% vulvar cancer
  - 85% vaginal cancer
  - 90-95% anal cancer in men and women
- HPV types 6 and 11 are responsible for:
  - 90% genital warts
  - Almost all cases of juvenile recurrent papillomatosis

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**Statistics for HPV**

- During 2008-2012 in the US, HPV caused:
  - ~39,000 HPV-associated cancers
  - 59% of those were in women
  - Stratification of data by state showed rates ranging from a low of 7.5/100,000 people in Utah to a high of 14.7/100,000 in Kentucky
  - U.S. Census Southern region contained the states with the highest rates of HPV-associated cancers
  - Your recommendation matters!

(CDC analyzed population-based cancer registry data)

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**Human Papillomavirus Vaccines**

- 9vHPV (Gardasil 9), 4vHPV (Gardasil), and 2vHPV (Cervarix)
- HPV9 is recommended in a 3-dose series for both females and males aged 11 or 12 years
- The vaccine series can be started beginning at age 9 years
- Administer the second dose 1 to 2 months after the first dose and the third dose 6 months after the first dose (at least 24 weeks after the first dose)
In the News (October 20, 2016)...

- Only 42% of teen girls and 28% of teen boys receive all three doses—CDC, 2016
- FDA and ACIP have recommended a two-dose schedule for children 9-14 years of age. Awaiting CDC approval
  - The second dose would be 6-12 months after the first
  - Those starting vaccination at age 15-26 should receive three doses (incentive to start earlier?)

Rationale behind the age of administration of HPV vaccine

- 1) Vaccine is most effective if it is administered before the individual begins engaging in sexual activity, mainly because the vaccine is inactive against HPV strains acquired before vaccination.
- 2) Children mount the most robust antibody responses to the vaccine when they are between the ages of 9 and 15 years. Antibody responses are twice as high in both genders 9-15 years of age as in those 16-26 years of age.

Human Papillomavirus Vaccine

- New footnote:
  - Administer HPV vaccine beginning at age 9 years to children and youth with any history of sexual abuse or assault who have not initiated or completed the 3-dose series

Vaccine Refusal

New AAP Clinical Report

- "Countering Vaccine Hesitancy”—Sept 2016
  - -- Dr. Kathryn Edwards and Dr. Jesse Hackell
  - The Committee on Infectious Diseases
  - The Committee on Practice and Ambulatory Medicine
  - For those families that refuse vaccines no matter what communication method is used, dismissal is now an AAP-approved option, but should be “a very last resort”

Dismissal conditions that need to be met first...

- The physician has exhausted all means of education with the family
- The family has been made aware of the office policy concerning dismissal of non-vaccinators
- The geographic area is not in short supply of pediatric providers
- The practice continues to provide health care until the family finds another provider (usually 30 days)
Your Profound Influence

• One observational study found that when physicians continue to engage families, up to 47% of parents ultimately agreed to have their children vaccinated after initially refusing.

New AAP Policy Statement

• “Medical Versus Nonmedical Immunization Exemptions for Child Care and School Attendance”—Sept 2016
  • Committee on Practice and Ambulatory Medicine
  • Committee on Infectious Disease
  • Committee on State Government Affairs
  • Council on School Health
  • Section on Administration and Practice Management

• Calls for all states to use their public health authority to eliminate non-medical or “personal belief” vaccine exemptions from immunization requirements for school entry.

Immunization Exemptions

• 18 states allow philosophical exemptions for those who object to immunizations because of personal, moral or other beliefs.
• Kentucky allows for religious exemptions, but not philosophical or personal belief.

Resources

Resources: Websites

• Centers for Disease Control (CDC): 2016 Immunization Schedules
  • www.cdc.gov/vaccines/schedules/downloads/downloads/hb00-13.pdf
• American Academy of Pediatrics (AAP)
  • www.aap.org/immunization
• Every Child by Two (ECBT)
  • www.everychildbytwo.org
• Immunization Action Coalition (IAC): SUBSCRIBE for weekly updates!
  • www.immunize.org and www.vaccineinformation.org
• National Network for Immunization Information (NNii)
  • www.immunizationinfo.org
• US Dept of Health and Human Services (HHS)
  • www.vaccines.gov
• Vaccine Education Center (VEC)
  • www.vaccine.chop.edu
Resources: Books for Parents

- Baby 411, 4th edition by Denise Fields and Ari Brown, MD
- Do Vaccines Cause That?! A Guide for Evaluating Vaccine Safety, 1st edition by Martin Myers, MD and Diego Pineda, MS
- Vaccines and Your Child, Separating Fact from Fiction, 2011 by Paul Offit, MD and Charlotte Moser

Resources: Videos

- "Vaccines and Your Baby"
- "Vaccines: Separating Fact from Fear"

www.chop.edu/service/vaccine-education-center/familyOrder.cfm
www.chop.edu/service/vaccine-education-center/related-information/multimedia.html

Resources: Phone Number

- CDC-INFO Contact Center
  - Call (800) CDC-INFO or (800) 232-4636
  - Operates 24/7 in English and Spanish

Resources: Phone Number

- Advisory Committee on Immunization Practices (ACIP) statement for detailed recommendations http://www.cdc.gov/vaccines/pubs/acip-list.htm
- www.immunize.org/protect-newborns
- "Nearing the end: The final stages of polio eradication". Muoio, Dave. Infectious Diseases in Children. August 2016; Vol 29; No 8.

References

- "Washington芙irus Outbreak: Teen Booster is Key". Medscape. Pediatric News, August 2012; Vol 46, No 9
- American Academy of Pediatrics (http://www.aap.org)
- "Reliable Sources of Immunization Information. Where to go to find answers." Immunization Action Coalition. (www.immunize.org/catg.d/p4012.pdf)