Childhood Immunization Update 2017

RICHARD K. ZIMMERMAN MD MPH FAAFP FIDSA

DONALD B. MIDDLETON MD
Conflicts of Interest

- Dr. Zimmerman: Research grants from Pfizer & Merck (adolescent vaccine) and Sanofi Pasteur
- Primarily federally funded
- Dr. Middleton: vaccine advisory boards for Merck & Co., Inc., Pfizer, GlaxoSmithKline, Sanofi Pasteur
ACIP/CDC Vaccination Policy considerations:

- Is the vaccine effective?
- Is the vaccine safe?
- Is the public health impact based on amount of potentially preventable disease sufficient?
- Is it programmatically feasible to add more injections?
- Is it cost-effective?
- ACIP uses GRADE to make recommendations
  - Explicit, evidence-based grading process
Changes in the 2017 Childhood Immunization Schedule

- The 16-year age column has been separated from the 17–18-year age column to highlight the need for a meningococcal conjugate vaccine booster dose at age 16 years.

- Live attenuated influenza vaccine (LAIV) has been removed.

- Blue bar added for HPV vaccine for children aged 9–10 years, indicating that persons in this age group may be vaccinated
  - (even in the absence of a high-risk condition)
  - Recommended if abuse an issue

- **New Figure 3:** Vaccines indicated for children and adolescents aged 18 years or younger based on medical indications
Table 1. Recommended Immunization Schedule for Children and Adolescents Aged 18 Years or Younger—United States, 2017.

*For those who fall behind or start late, see the catch-up schedule (Figure 2).*

These recommendations must be read with the footnotes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars in Figure 1. To determine minimum intervals between doses, see the catch-up schedule (Figure 2). School entry and adolescent vaccine age groups are shaded in gray.

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Birth</th>
<th>1 mo</th>
<th>2 mos</th>
<th>4 mos</th>
<th>6 mos</th>
<th>9 mos</th>
<th>12 mos</th>
<th>15 mos</th>
<th>18 mos</th>
<th>19-23 mos</th>
<th>2-3 yrs</th>
<th>4-6 yrs</th>
<th>7-10 yrs</th>
<th>11-12 yrs</th>
<th>13-15 yrs</th>
<th>16 yrs</th>
<th>17-18 yrs</th>
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<td>Hepatitis B (HepB)</td>
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<td>Rotavirus (RV/RV) (2-dose series); RV5 (3-dose series)</td>
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<td>Diphtheria, tetanus, &amp; acellular pertussis (DTPaP; &lt;7 yrs)</td>
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<td>Haemophilus influenza type b (Hib)</td>
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<tr>
<td>Inactivated poliovirus (IPV; &lt;18 yrs)</td>
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<td>Measles, mumps, rubella (MMR)</td>
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<td>Varicella (VAR)</td>
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<td>1st</td>
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<td>Hepatitis A (HepA)</td>
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<tr>
<td>Meningococcal (Hib-MenCY 6 weeks; MenACWY 3 mos; MenACWY CRM 32 mos)</td>
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<tr>
<td>Tetanus, diphtheria, &amp; acellular pertussis (Tdap; &gt;7 yrs)</td>
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<tr>
<td>Human papillomavirus (HPV)</td>
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<td>2nd</td>
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<tr>
<td>Meningococcal B (MenB)</td>
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<tr>
<td>Pneumococcal polysaccharide (PPSV23)</td>
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<td></td>
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<td>1st</td>
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</tbody>
</table>

**NOTE:** The above recommendations must be read along with the footnotes of this schedule.
FIGURE 2. Catch-up immunization schedule for persons aged 4 months through 18 years who start late or who are more than 1 month behind—United States, 2017.

The figure below provides catch-up schedules and minimum intervals between doses for children whose vaccinations have been delayed. A vaccine series does not need to be restarted, regardless of the time that has elapsed between doses. Use the schedule appropriate for the child's age. Always use this table in conjunction with Figure 1 and the footnotes that follow.

### Children age 4 months through 6 years

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Minimum Age for Dose 1</th>
<th>Dose 1 to Dose 2</th>
<th>Minimum Interval Between Doses</th>
<th>Dose 2 to Dose 3</th>
<th>Dose 3 to Dose 4</th>
<th>Dose 4 to Dose 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis B</td>
<td>Birth</td>
<td>4 weeks</td>
<td></td>
<td>8 weeks and at least 16 weeks after first dose. Minimum age for the final dose is 24 weeks.</td>
<td></td>
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</tr>
<tr>
<td>Rotavirus</td>
<td>6 weeks</td>
<td>4 weeks</td>
<td></td>
<td>4 weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diphtheria, tetanus, and acellular pertussis</td>
<td>6 weeks</td>
<td>4 weeks</td>
<td></td>
<td>4 weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haemophilus influenzae type b</td>
<td>6 weeks</td>
<td>4 weeks</td>
<td>if first dose was administered before the 1st birthday.</td>
<td>8 weeks (as final dose)</td>
<td>if first dose was administered at age 12 through 14 months.</td>
<td>No further doses needed if first dose was administered at age 15 months or older.</td>
</tr>
<tr>
<td>Pneumococcal</td>
<td>6 weeks</td>
<td>4 weeks</td>
<td>if first dose administered before the 1st birthday.</td>
<td>8 weeks (as final dose for healthy children)</td>
<td>if first dose was administered at the 1st birthday or after.</td>
<td>No further doses needed for healthy children if first dose was administered at age 24 months or older.</td>
</tr>
<tr>
<td>Inactivated poliovirus</td>
<td>6 weeks</td>
<td>4 weeks</td>
<td></td>
<td>4 weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measles, mumps, rubella</td>
<td>12 months</td>
<td>4 weeks</td>
<td></td>
<td>4 weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Varicella</td>
<td>12 months</td>
<td>3 months</td>
<td></td>
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</tr>
<tr>
<td>Hepatitis A</td>
<td>12 months</td>
<td>6 months</td>
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</tbody>
</table>

### Meningococcal (Hib-MenCY:23v; MenACWY-D:29v mos; MenACWY-CRM:22v mos) | 6 weeks | 8 weeks | See footnote 11 | | | |

### Children and adolescents age 7 through 18 years

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Minimum Age for Dose 1</th>
<th>Dose 1 to Dose 2</th>
<th>Minimum Interval Between Doses</th>
<th>Dose 2 to Dose 3</th>
<th>Dose 3 to Dose 4</th>
<th>Dose 4 to Dose 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meningococcal</td>
<td>Not Applicable (N/A)</td>
<td>8 weeks</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Tetanus, diphtheria; tetanus, diphtheria, and acellular pertussis</td>
<td>7 years</td>
<td>4 weeks</td>
<td></td>
<td>4 weeks if first dose of DTaP/DT was administered before the 1st birthday.</td>
<td>6 months (as final dose) if first dose of DTaP/DT or Tdap/Td was administered at or after the 1st birthday.</td>
<td></td>
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<tr>
<td>Human papillomavirus</td>
<td>9 years</td>
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<tr>
<td>Hepatitis A</td>
<td>N/A</td>
<td>6 months</td>
<td></td>
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<tr>
<td>Hepatitis B</td>
<td>N/A</td>
<td>4 weeks</td>
<td></td>
<td>8 weeks and at least 16 weeks after first dose.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inactivated poliovirus</td>
<td>N/A</td>
<td>4 weeks</td>
<td></td>
<td>4 weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measles, mumps, rubella</td>
<td>N/A</td>
<td>4 weeks</td>
<td></td>
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<tr>
<td>Varicella</td>
<td>N/A</td>
<td>3 months if younger than age 13 years. 4 weeks if age 13 years or older.</td>
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</tbody>
</table>

NOTE: The above recommendations must be read along with the footnotes of this schedule.
Figure 3. Vaccines that might be indicated for children and adolescents aged 18 years or younger based on medical indications

<table>
<thead>
<tr>
<th>VACCINE ▼</th>
<th>INDICATION ▲</th>
<th>Pregnancy</th>
<th>Immunocompromised status (excluding HIV infection)</th>
<th>HIV Infection CD4+ count (cells/μL)</th>
<th>Kidney failure, end-stage renal disease, on hemodialysis</th>
<th>Heart disease, chronic lung disease</th>
<th>CSF leaks/codleak implants</th>
<th>Asplenia and persistent complement component deficiencies</th>
<th>Chronic liver disease</th>
<th>Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis B&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
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<tr>
<td>Rotavirus&lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>Diphtheria, tetanus, &amp; acellular pertussis&lt;sup&gt;3&lt;/sup&gt; (DTaP)</td>
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<tr>
<td>Haemophilus influenza type b&lt;sup&gt;4&lt;/sup&gt;</td>
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<tr>
<td>Pneumococcal conjugate&lt;sup&gt;5&lt;/sup&gt;</td>
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<tr>
<td>Inactivated poliovirus&lt;sup&gt;6&lt;/sup&gt;</td>
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<td>Influenza&lt;sup&gt;7&lt;/sup&gt;</td>
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<tr>
<td>Measles, mumps, rubella&lt;sup&gt;8&lt;/sup&gt;</td>
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<tr>
<td>Varicella&lt;sup&gt;9&lt;/sup&gt;</td>
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<tr>
<td>Hepatitis A&lt;sup&gt;10&lt;/sup&gt;</td>
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<tr>
<td>Meningococcal ACWY&lt;sup&gt;11&lt;/sup&gt;</td>
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<tr>
<td>Tetanus, diphtheria, &amp; acellular pertussis&lt;sup&gt;12&lt;/sup&gt; (Tdap)</td>
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<tr>
<td>Pneumococcal polysaccharide&lt;sup&gt;15&lt;/sup&gt;</td>
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</tbody>
</table>

- Vaccination according to the routine schedule recommended
- Recommended for persons with an additional risk factor for which the vaccine would be indicated
- Vaccination is recommended, and additional doses may be necessary based on medical condition. See footnotes.
- No recommendation
- Contraindicated
- Precaution for vaccination

*Severe Combined Immunodeficiency

NOTE: The above recommendations must be read along with the footnotes of this schedule.
Changes in the 2017 Childhood Immunization Schedule Footnotes

- Hepatitis B vaccine footnote: birth dose should be administered within 24 hours of birth.
- Hib footnote:
  - Comvax was removed from the market
  - Hiberix may be used for the primary series
- 2-dose Trumenba (meningococcal B vaccine) series for non-emergent vaccination
Changes in the 2017 Childhood Immunization Schedule Footnotes

- Tdap for pregnant adolescents preferred for earlier in the 27–36 week period to maximize passive antibody transfer.
- HPV vaccine updated to include the new 2-dose schedule for persons initiating the series before age 15 years.
- In addition, bivalent HPV vaccine has been removed from the market.
Neisseria meningitidis

Thanks to
Lee H. Harrison, MD
for many of the slides

- Estimated annual 500,000 cases, 50,000 deaths
- Occurs in epidemics, outbreaks, and sporadic cases
- Transmission via respiratory droplets from carriers
- Incidence and serogroup distribution highly variable and dynamic
- Complications: meningitis, meningococcemia, pneumonia
- Case fatality around 10-20%
- 11%-19% of survivors suffer from sequelae
Geographic Variability of Meningococcal Disease

Serogroup Distribution

- **Canada** 2006
  - n = 210
  - B (35%)
  - C (31%)
  - Y (25%)
  - Other (9%)

- **United States** 2008
  - n = 1,172
  - B (69%)
  - C (26%)
  - W (2%)
  - Other (2%)

- **Latin America and the Caribbean** 2005
  - n = 1,391
  - C (28%)
  - B (69%)
  - Y (2%)
  - W (2%)

- **European Union** 2006
  - n = 5,223
  - B (76%)
  - Y (17%)
  - C (6%)
  - Other (4%)

- **African Meningitis Belt** 2006
  - n = 2,192
  - B (84%)
  - C (8%)
  - W (2%)
  - Other (6%)

- **Taiwan** 2001
  - n = 43
  - A (91%)
  - W (6%)
  - Other (1%)

- **Australia** 2007
  - n = 304
  - B (83%)
  - C (11%)
  - Other (6%)

- **New Zealand** 2007
  - n = 105
  - B (83%)
  - C (11%)
  - Other (6%)
Meningococcal Incidence in Adolescents and Young Adults by Serogroup, 2005-14, US

Source: National Notifiable Diseases Surveillance System (NNDSS) data with additional serogroup data from Active Bacterial Core surveillance (ABCs) and state health departments. Unknown serogroup (21%) and other serogroups (7%) excluded.
Why are Conjugate Vaccines Better Than Polysaccharide Vaccines?

<table>
<thead>
<tr>
<th>Property</th>
<th>Polysaccharide</th>
<th>Conjugate</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-cell-dependent immune response</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Immune memory</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Persistence of protection</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Booster effect</td>
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<td>Yes</td>
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<tr>
<td>Reduction of carriage</td>
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<td>Yes</td>
</tr>
<tr>
<td>Herd effect</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Lack of hyporesponsiveness</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Immunogenic in infants</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**MenACWY Vaccine Effectiveness:** at <1 yr after vaccination = 79%; 1-<3 yr = 69%; 3-<8 yrs = 61%

So TWO doses needed age 11-12 yrs and age 16 yrs; only one dose age ≥16 yrs

Recent serogroup B clusters, U.S. universities

<table>
<thead>
<tr>
<th>Setting</th>
<th>Dates</th>
<th># Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio University</td>
<td>Jan 2008-Nov 2010</td>
<td>13*</td>
</tr>
<tr>
<td>University of Pennsylvania</td>
<td>Feb-March 2009</td>
<td>4</td>
</tr>
<tr>
<td>Lehigh University</td>
<td>November 2011</td>
<td>2</td>
</tr>
<tr>
<td>Princeton University</td>
<td>March 2013-2014</td>
<td>9*</td>
</tr>
<tr>
<td>UC Santa Barbara</td>
<td>November 2013</td>
<td>4</td>
</tr>
<tr>
<td>Providence College</td>
<td>January-February 2014</td>
<td>2</td>
</tr>
<tr>
<td>University of Oregon</td>
<td>January-May 2015</td>
<td>7*</td>
</tr>
<tr>
<td>Santa Clara University</td>
<td>January-February 2016</td>
<td>2</td>
</tr>
<tr>
<td>Rutgers University</td>
<td>March-April 2016</td>
<td>2</td>
</tr>
<tr>
<td>U. Wisconsin-Madison</td>
<td>October 2016</td>
<td>3</td>
</tr>
<tr>
<td>Oregon State University</td>
<td>November 2016</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>50 cases, 3 deaths</td>
</tr>
</tbody>
</table>

*1 fatality; note thousands of students/staff in university
Two FDA-licensed protein-based group B vaccines

- **Bexsero**: GSK/Novartis: single protein variant; MenB-4C
  - Licensed in U.K. and recommended for all infants
  - FDA licensed January 23, 2015; approved age ≥10 yrs

- **Trumenba**: Pfizer: two protein variants; Men-FHbp
  - FDA licensed October 26, 2014; approved age ≥10 yrs
  - Immunogenic and acceptable safety profile
  - VE: unknown; useful for outbreaks (?)
  - Theoretical possible concern for autoimmunity issues so large safety data analyses needed
  - CANNOT mix these 2 vaccines; need to use one or other
Advisory Committee on Immunization Practices recommendations on group B meningococcal vaccines

- **February 2015 meeting**: Category A recommendation (all persons without contraindication) for high risk groups
  - Medical conditions high risk for meningococcal disease
    - Complement component deficiencies
    - Anatomic or functional asplenia
  - Microbiologists
  - Outbreak response

- **June 2015 meeting**: Category B recommendation (“clinical decision making”) for 16-23 year olds
  - Very low burden of disease
  - Scientific unknowns
  - Preferably at 16-18 years if vaccinated
Polio

- Only type 1 is still circulating.
Flu Vaccines for Children

- FluLaval (ID Biomedical/GSK): ≥ 6 months
- Fluzone (Sanofi): ≥ 6 months
- Fluarix (GSK): ≥ 3 years
- Flucelvax (Seqirus): ≥ 4 years
- Fluvirin (Seqirus): ≥ 4 years
- Afluria (Seqirus): ≥ 9 years
- Flublok (Protein Sources): ≥ 18 years
- Fluzone Intradermal (Sanofi): ≥ 18 years

Quadrivalent better for children: 2 X As and 2 X Bs; Bs are more dangerous for children than for elderly

NOT FluMist (MedImmune): not recommended
Why Quadrivalent?

- Two type As: H1N1 and H3N2
- Two type Bs: Victoria and Yamagata
- Hard to tell which B will circulate: often both
- B may account for 8-10% of flu cases; often second wave
- Worse for children and adolescents who have not encountered B repetitively before; older folks may be partially protected
- Respiratory failure, heart attack, stroke, and death
Percentage of Visits for Influenza-like Illness (ILI) Reported by the U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet), Weekly National Summary, 2016-2017 and Selected Previous Seasons
Influenza Positive Tests Reported to CDC by U.S. Public Health Laboratories, National Summary, 2016-2017 Season

- A (subtyping not performed)
- A (H1N1)pdm09
- A (H3N2)
- H3N2v
- B (lineage not performed)
- B (Victoria Lineage)
- B (Yamagata Lineage)
2016-2017 Influenza Facts

- 40 pediatric deaths
- Vaccine coverage rate: 37.3% for age 6 months through 17 years
- Vaccine VE: 32% for age 6 months-17 years
  - Usually better for B than A
- Vaccine VE: 53% for age 6 months-8 years
HPV as Cause of Cancer

- Cervical cancer: >90%
- Anal cancer: >90%
- Penile cancer: >60%
- Vulvar cancer: 70%
- Vaginal cancer: 70%
- Oropharynx: 70%

https://www.cdc.gov/cancer/hpv/statistics/
Accessed 2.21.2017
# HPV Vaccine History & Availability, US

<table>
<thead>
<tr>
<th>Vaccination</th>
<th>Licensed Year</th>
<th>ACIP Recommendation</th>
<th>Other Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bivalent</strong> (HPV 16, 18)</td>
<td>2009</td>
<td>2009</td>
<td>No longer supplied; supplies exhausted 2016</td>
</tr>
<tr>
<td><strong>Quadrivalent</strong> (HPV 6, 11, 16, 18)</td>
<td>2006</td>
<td>2006 (females) 2009 (males)</td>
<td>No longer shipped October 2016</td>
</tr>
<tr>
<td><strong>9-Valent</strong> (HPV 6, 11, 16, 18, 31, 33, 45, 52, 58)</td>
<td>December 2014</td>
<td>February 2015</td>
<td></td>
</tr>
</tbody>
</table>
HPV-Associated Disease

- HPV types 16, 18 are responsible for:
  - 66% of cervical cancers
  - 64% of invasive cervical cancers

- Additional HPV types in 9-valent vaccination cover:
  - 15% of cervical cancers
  - 10% of invasive cervical cancers
Immunologic Basis of HPV Vaccination Schedules

- 3-dose schedule (0, 1-2, 6 months) –
  - Considered “prime-prime-boost”
- 2-dose schedule (0, 6 months) –
  - Considered “prime-boost”
- Memory B cells require at least 4-6 months to mature and differentiate into high-affinity B cells
- ~6 month interval between first and last dose allows last dose to efficiently reactivate memory B cells
- From ACIP/CDC slides
Immunogenicity of 2-Dose 9vHPV Schedules

- Main analyses are 2 doses in ~9–14 year olds vs 3 doses in 16–26 years
  - Comparison is age group and schedule for which efficacy demonstrated
  - No established minimum antibody threshold for protection
  - Trials found antibody response after 2 doses (0.6 or 0.12 months) in 9–14 year olds is non-inferior to that after 3 doses in older group
  - 1500 enrolled

- Based on data from immunogenicity trials, regulatory authorities have approved 2- dose HPV vaccination schedules*

*
9vHPV 2-dose Trial: Non-inferior GMT at 1 Month Post-Last Dose in 2-dose (0, 6) Girls vs. 3-dose (0, 2, 6) Women

The non-inferiority criterion was met for all 9 HPV types (all p<0.001)

Luxembourg, presented to ACIP, February 2016
9vHPV 2-dose Study: Non-inferior GMT at 1 Month Post-Last Dose in 2-dose (0, 6) Boys vs. 3-dose (0, 2, 6) Women

The non-inferiority criterion was met for all 9 HPV types (all p<0.001)

<table>
<thead>
<tr>
<th>Anti-HPV</th>
<th>Boys (0,6)</th>
<th>Women (0,2,6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>2.02</td>
<td>2.02</td>
</tr>
<tr>
<td>11</td>
<td>2.45</td>
<td>2.45</td>
</tr>
<tr>
<td>16</td>
<td>2.69</td>
<td>2.69</td>
</tr>
<tr>
<td>18</td>
<td>2.44</td>
<td>2.44</td>
</tr>
<tr>
<td>31</td>
<td>2.62</td>
<td>2.62</td>
</tr>
<tr>
<td>33</td>
<td>2.99</td>
<td>2.99</td>
</tr>
<tr>
<td>45</td>
<td>1.65</td>
<td>1.65</td>
</tr>
<tr>
<td>52</td>
<td>1.76</td>
<td>1.76</td>
</tr>
<tr>
<td>58</td>
<td>2.70</td>
<td>2.70</td>
</tr>
</tbody>
</table>

Fold difference (boys/women) | 2.02 | 2.45 | 2.69 | 2.44 | 2.62 | 2.99 | 1.65 | 1.76 | 2.70 |

95% CI | (1.73, 2.36) | (2.09, 2.88) | (2.29, 3.15) | (2.04, 2.92) | (2.20, 3.12) | (2.55, 3.50) | (1.37, 1.99) | (1.51, 2.05) | (2.30, 3.16) |
9vHPV 2-dose Study: GMT Comparison at 1 Month Post-Last Dose in 2-dose (0, 6) Girls vs. 3-dose (0, 2, 6) Girls

<table>
<thead>
<tr>
<th>Anti-HPV</th>
<th>Girls (0,6)</th>
<th>Girls (0,2,6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1.11</td>
<td>(0.94, 1.30)</td>
</tr>
<tr>
<td>11</td>
<td>1.06</td>
<td>(0.90, 1.25)</td>
</tr>
<tr>
<td>16</td>
<td>1.14</td>
<td>(0.98, 1.34)</td>
</tr>
<tr>
<td>18</td>
<td>0.91</td>
<td>(0.77, 1.09)</td>
</tr>
<tr>
<td>31</td>
<td>0.82</td>
<td>(0.69, 0.97)</td>
</tr>
<tr>
<td>33</td>
<td>1.29</td>
<td>(1.10, 1.52)</td>
</tr>
<tr>
<td>45</td>
<td>0.54</td>
<td>(0.45, 0.65)</td>
</tr>
<tr>
<td>52</td>
<td>0.64</td>
<td>(0.55, 0.75)</td>
</tr>
<tr>
<td>58</td>
<td>1.02</td>
<td>(0.87, 1.20)</td>
</tr>
</tbody>
</table>
ACIP HPV vaccination recommendations: Routine, catch-up age and MSM (unchanged)

- Routine HPV vaccination for girls and boys at 11 or 12 years.
  - May start at 9 years
  - Abuse

- Catch-up vaccination
  - Females through age 26 years and
  - Males through age 21 years.
  - Males aged 22 through 26 years may be vaccinated.

- Special population:
  - For men who have sex with men (MSM), ACIP recommends routine HPV vaccination as for all males, and initiation of vaccination through age 26 years for those who were not adequately vaccinated previously.
Recommended number of doses and dosing schedule

<table>
<thead>
<tr>
<th>Population</th>
<th>Recommended number of HPV vaccine doses</th>
<th>Recommended interval between doses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons initiating HPV vaccination at ages 9 through 14 years,* except immunocompromised persons†</td>
<td>2</td>
<td>0, 6–12 months§</td>
</tr>
<tr>
<td>Persons initiating HPV vaccination at ages 15 through 26 years* and immunocompromised persons† initiating HPV vaccination at ages 9 through 26 years</td>
<td>3</td>
<td>0, 1–2, 6 months**</td>
</tr>
</tbody>
</table>

* In a 2-dose schedule of HPV vaccine, the minimum interval is 5 months between the first and second dose
† In a 3-dose schedule of HPV vaccine, the minimum intervals are 4 weeks between the first and second dose, 12 weeks between the second and third dose, and 5 months between the first and third dose

SAFETY: no major events linked to HPV vaccines
Interrupted series

- 9vHPV may be used to continue or complete a series started with 4vHPV or 2vHPV.
- If the vaccine schedule is interrupted, the vaccination series does not need to be restarted.
- Number of recommended doses is based on age at administration of the first dose.
- No recommendation to revaccinate those given 2vHPV or 4vHPV with 9vHPV
HPV Vaccine for Adolescents with Immunocompromising Medical Conditions

- For **immunocompromised** females and males aged 9 through 26 years with **three** doses of HPV vaccine (0, 1–2, 6 months).

  - Primary or secondary immunocompromising conditions that might reduce cell-mediated or humoral immunity, such as B lymphocyte antibody deficiencies, T lymphocyte complete or partial defects, HIV infection, malignant neoplasm, transplantation, autoimmune disease, or immunosuppressive therapy, since immune response to vaccination may be attenuated.*

* The recommendation for a 3-dose schedule does not apply to children aged <15 years with asplenia, asthma, chronic granulomatous disease, chronic heart/liver/lung/renal disease, CNS anatomic barrier defects (e.g., cochlear implant), complement deficiency, diabetes, or sickle cell disease. Use 2 doses.
Estimated Vaccination Coverage among Adolescents Aged 13–17 Years, NIS-Teen, United States, 2006-2015

- Routine HPV recommendation for females
- Routine HPV recommendation for males
- Revised APD* definition
  - ≥1 Tdap
  - ≥1 MenACWY
  - ≥1 HPV (F)
  - ≥1 HPV (M)
  - ≥3 HPV (F)
  - ≥3 HPV (M)

* APD = Adequate provider data

Source: Reagan-Steiner MMWR 2016
Evidence Review: Task Force on Community Preventive Services

- **Increase Patient Demand**
  - Patient reminders

- **Enhance Access**
  - Office hours express vaccination
  - After hours express vaccine-only clinics

- **Provider Reminders and Office Systems**
  - Standing order programs (SOPs)
  - Prompts in EMRs

- Combination of 2 or 3 strategic approaches led to a **16% point increase** in rates.

- Multiple interventions within a single strategic approach increased rates only **4% points**.
The Solution – 4 Pillars™

1. Convenient Vaccine Services
2. Patient Communication
3. Enhanced office systems
4. Motivation/Champion

4PillarsTransformation.pitt.edu
4 Pillar™ Transformation Program Results

Outcomes from clinical trials of the 4 Pillars™ Practice Transformation Program
Pillar 1: Convenient Vaccination Programs

- **Extended vaccination season**
  - Starts when influenza vaccine arrives
  - Continues into the influenza disease season for unvaccinated
    - Season unpredictable & some benefit possible
    - 2 waves of influenza may occur

- **Express vaccination services**
  - Vaccination only services:
    - Dedicated evening or weekend vaccine-only services
    - Walk-in vaccination station
    - Nursing vaccination visits
Pillar 2: Patient Communication

- Convenient Vaccination Services
- Notification Methods
  - Autodialer; Email/text; Office posters/videos; Answering service “on-hold” messages; Mail
- Physician recommendation is essential

MMWR 1988;37:657-61
Providers should discuss serious nature of vaccine preventable diseases

Families Fighting Flu
www.familiesfightingflu.org
Pillar 3: Enhanced Office Vaccination Systems

- **Assessment of vaccination** as a routine part of the office visit by nursing staff at check-in/rooming:
  - Prompts in EMR
  - Health maintenance or immunization section review
  - Routinely address “Is vaccination status up to date?” as part of vital signs
- **Empowering staff to vaccinate** by standing orders
- **Combination of assessment and SOPs** should reduce missed opportunities
Pillar 4: Motivation by Immunization Champion

- Ongoing motivation is a key to success
  - Set goals for improving rates
  - Identify an Immunization Champion
  - Champion monitors weekly progress towards goals
  - Shares progress with team
  - Celebrate achievements
    - Consider rewards
Links to Resources

- SHOTS IMMUNIZATIONS
  www.immunizationed.org/shotsonline.aspx
  - Detailed information on specific vaccines
  - Click on buttons for more details
  - On phones: stfm.org/shots
- CDC www.cdc.gov/vaccines
- IAC: www.immunize.org