PEDIATRIC VACCINE UPDATES & RECOMMENDATIONS FOR HEALTHCARE PROFESSIONALS
Brett Hurliman, MD
Arizona Osteopathic Medical Association
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DISCLOSURE STATEMENT

• I do not have any relevant financial relationships with any commercial interests.

• I do not intend to discuss an unapproved/investigative use of a commercial product/device in my presentation.
OBJECTIVES

• Understand the basic concepts of vaccination immunology and the rationale for current vaccine schedule.
• Discuss human papillomavirus [HPV] epidemiology and new vaccine recommendations.
• Review influenza vaccine effectiveness data and 2018 recommendations for use.
OVERVIEW OF THE IMMUNE SYSTEM

Innate (non-specific)
- Neutrophils, macrophages, monocytes, antigen-presenting cells (e.g., dendritic cells)
- Physical and physiological barriers: skin, mucosal surfaces, hormonessa
- Proteins: toll-like receptors, pattern recognition receptors, cytokines, acute phase reactants, complement system

Adaptive (specific)
- T cells: T helper cells, CD8, Th1 cells, Follicular helper cells (Tfh), cytotoxic T cells (CD8), memory T cells, regulatory T cells, natural killer T cells
- B cells: plasma cells, memory B cells, regulatory B cells

Figure 1. The immune system can be broadly classified into innate and adaptive, and both systems work with much interaction with each other.

INNATE IMMUNE SYSTEM

- More primitive form of defense that includes physical, physiological, and cellular barriers.
- Followed by an adaptive response, with antigen-presenting cells forming a link between the two systems.
**ADAPTIVE IMMUNE SYSTEM**

- Takes more time to develop, but lasts longer and produces a more robust immune response.
- Targeted response to foreign antigens via T- and B-cells, creating immunologic memory.
- This response is the major target of vaccinations.

**GENERATION OF IMMUNITY TO VACCINATIONS**

**T-cell Dependent Response**
- Activation of both B-cells and T-cells
- Protein antigens

**T-cell Independent Response**
- Direct activation of B-cells, resulting in the production of antibodies
- Polysaccharide antigens

- B-cells: produce antibodies
- Understanding the process of how immunity is generated is important in understanding the vaccine schedule.
T-CELL DEPENDENT REACTION

• Triggered by protein antigens, which activate both dendritic cells (T-cells) and B-cells.
• Activated cells travel to lymph node germinal centers.
• Stimulate helper cells (T-cells) to produce massive proliferation of B-cells.
• B-cells become memory B-cells or antibody-producing plasma cells.
**T-CELL DEPENDENT REACTION**

- Triggered by polysaccharide antigens, which activate B-cells to differentiate into plasma cells.
- These plasma cells produce antigen-specific antibodies (short-lived).
- No generation of immune memory.

**T-CELL INDEPENDENT REACTION**

- Triggered by polysaccharide antigens, which activate B-cells to differentiate into plasma cells.
- These plasma cells produce antigen-specific antibodies (short-lived).
- No generation of immune memory.
T-CELL INDEPENDENT REACTION

RA T I O N A L E F O R I MM U N I Z A T I O N S C H E D U L E

Underlying goal is to achieve effective, lasting immunity against diseases.
Table 1: Recommended Child and Adolescent Immunization Schedule for ages 18 years or younger
United States, 2019

<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>8 mos</th>
<th>10 mos</th>
<th>12 mos</th>
<th>15 mos</th>
<th>18 mos</th>
<th>24 mos</th>
<th>30 mos</th>
<th>36 mos</th>
<th>48 mos</th>
<th>60 mos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis B (HepB)</td>
<td>1st</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Rotavirus (RV) RV1 (2-dose series) RV5 (1-dose series)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Diphtheria, tetanus, &amp; acellular pertussis (DTaP)</td>
<td>1st</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Haemophilus influenzae type b (Hib)</td>
<td>1st</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pneumococcal conjugate (PCV13)</td>
<td>1st</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Inactivated poliovirus (IPV; ≥3 yrs)</td>
<td>1st</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Influenza (IV)</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Range of recommended ages for all children
Range of recommended ages for certain high-risk groups
Range of recommended ages for certain high-risk groups
No recommendation

AGE OF FIRST DOSE & 2-, 4-, 6-MONTH SCHEDULE

<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>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis B (HepB)</td>
<td>1st</td>
<td></td>
<td></td>
<td></td>
<td>2nd</td>
</tr>
<tr>
<td>Rotavirus (RV) RV1 (2-dose series) RV5 (1-dose series)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2nd</td>
</tr>
<tr>
<td>Diphtheria, tetanus, &amp; acellular pertussis (DTaP; ≥7 yrs)</td>
<td>1st</td>
<td></td>
<td></td>
<td></td>
<td>2nd</td>
</tr>
<tr>
<td>Haemophilus influenzae type b (Hib)</td>
<td>1st</td>
<td></td>
<td></td>
<td></td>
<td>2nd</td>
</tr>
<tr>
<td>Pneumococcal conjugate (PCV13)</td>
<td>1st</td>
<td></td>
<td></td>
<td></td>
<td>2nd</td>
</tr>
<tr>
<td>Inactivated poliovirus (IPV; ≥3 yrs)</td>
<td>1st</td>
<td></td>
<td></td>
<td></td>
<td>2nd</td>
</tr>
<tr>
<td>Influenza (IV)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**AGE OF FIRST DOSE & 2-, 4-, 6-MONTH SCHEDULE**

- Priming doses are required to generate immune memory.
  - Initial doses that generate germinal center reaction
  - Result in production of memory B-cells and antibody-producing plasma cells
- Immunization prior to 6 weeks of age results in a weaker response due to immune system immaturity.
- Minimum of 3 weeks between primary doses prevents interference of primary waves of immune response.
  - Self-terminates in 3-6 weeks
  - Vaccines are spaced out at 4-8 week intervals to avoid competing immune responses.

**PRIME-BOOST SCHEDULE**

- **Affinity Maturation**
  - Process by which memory B-cells complete the process of developing antigen specificity.
  - Takes approximately 4-6 months.
- Allowing at least a 6-month interval between last primary dose and first booster dose allows for completion of this process.
  - Development of highly specific memory B-cells
  - The longer the gap, the better the immune persistence.
  - Allow for maintenance of sustained antibody levels.
MEASLES/ MUMPS/ RUBELLA & VARICELLA VACCINES

- Live vaccines always generate the most powerful immune responses.
  - Amount of antigen exposure results in multiple primary response all over body
- Generate lifelong immunity, detectable for decades.
- Given only after the age of 6 months to avoid neutralization by maternal antibodies.
- If vaccinated after the age of 12 months, 95-98% of children develop protective antibodies to measles.
  - Second dose given (at age 4 years) to protect the minority of children (~5%) that do not develop protective antibodies with first dose.
OBJECTIVES

• Understand the basic concepts of vaccination immunology and the rationale for current vaccine schedule.
• Discuss human papillomavirus [HPV] epidemiology and new vaccine recommendations.
• Review influenza vaccine effectiveness data and 2018 recommendations for use.

HUMAN PAPILLOMAVIRUS VACCINE
HUMAN PAPILLOMAVIRUS

- DNA virus.
- Over 170 known types.
- Transmitted by direct skin-to-skin contact
  - More than 40 types are transmitted by sexual contact.
- Risk Factors:
  - Early onset of sexual activity
  - Multiple sexual partners
  - Smoking
  - Poor immune function/immunodeficiency

HUMAN PAPILLOMAVIRUS

- Most common sexually transmitted infection, both globally and in the United States.
- Highest prevalence occurs in sexually active adolescents and young adults.
- First infection occurs soon after onset of sexual activity.
- Lifetime risk of HPV is around 80%
HPV TYPES & INFECTIONS

- About 40 types infect the genital tract
- High-risk types (oncogenic): 16/18/31/33/45/52/58
  - Responsible for virtually all cervical cancers and high-risk dysplasias
  - Genotypes 16/18 cause 70% of cervical cancers and 90% of HPV-related neoplasms at other sites
  - 90% of anal cancers
  - 70% of vaginal cancers
  - 50% of penile cancers
  - Up to 70% of oropharyngeal cancers.
- Low-risk types (non-oncogenic): 6/11
  - 90% of all genital warts
  - Juvenile recurrent respiratory papillomatosis

http://www.cdc.gov/cancer/hpv/statistics/cases.htm
Number of HPV-Associated and HPV-Attributable Cancer Cases per Year

- Cancer probably caused by HPV type
- HPV types 16/18
- HPV types 31/33/45/52/58
- Other HPV types
- HPV-negative*

**Women**
- Cervix
- Vagina
- Vulva
- Anus
- Rectum
- Oropharynx

**Men**
- Penis
- Anus
- Rectum
- Oropharynx

The number of HPV-associated oropharyngeal cancers is increasing by 2.5% each year. Projected to surpass annual number of cervical cancers by 2020.

http://www.cdc.gov/cancer/hpv/statistics/cases.htm

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HPV INFECTION & ADOLESCENTS

- Majority of infections are asymptomatic, undetectable, and resolve spontaneously in 1-2 years.
- Clinical manifestations:
  - Genital Warts
    - Approximately 360,000 new cases every year
  - Juvenile Recurrent Respiratory Papillomatosis
    - 1500-3000 new pediatric cases every year
  - Intraepithelial lesions of increasing abnormality
    - Cervical, Vaginal, Vulvar, Anal
    - Persistent infection can lead to cancer
HPV VACCINES

<table>
<thead>
<tr>
<th></th>
<th>Bivalent</th>
<th>Quadrivalent</th>
<th>9-valent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year Licensed</td>
<td>2009</td>
<td>2006</td>
<td>2014</td>
</tr>
<tr>
<td>Target Types</td>
<td>16, 18</td>
<td>6, 11, 16, 18</td>
<td>6, 11, 16, 18, 31, 33, 45, 52, 58</td>
</tr>
<tr>
<td>Licensed Use</td>
<td>Females 9-25 years</td>
<td>Female 9-26 yrs</td>
<td>Females 9-26 yrs</td>
</tr>
</tbody>
</table>

- **Bivalent vaccine**
  - Administered in 3 doses, given at 0, 1, and 6 months.
- **Quadrivalent and 9-valent**
  - Administered in 3 doses, given at 0, 2, and 6 months.

- **October 20, 2016**
- FDA and ACIP have approved a 2-dose series for HPV vaccination for children age 9-14 years.
  - If vaccination series is started **PRIOR TO** 15th birthday, need 2 doses >6 months apart
  - If vaccination series is started **AFTER** 15th birthday, should follow/continue traditional 3-dose series
- Reviewed and quickly approved by CDC Director.
- Goal is to improve lagging completion rates of the series while providing protection against HPV.
FIGURE. Estimated coverage with selected vaccines and doses* among adolescents aged 13–17 years, by survey year and ACIP recommendations—National Immunization Survey—Teen, United States, 2006–2017

<table>
<thead>
<tr>
<th>Year</th>
<th>USA</th>
<th>AZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>65.5%</td>
<td>65.0%</td>
</tr>
<tr>
<td>≥1 dose</td>
<td>HPV,</td>
<td>48.6%</td>
</tr>
<tr>
<td>UTD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: ACIP = Advisory Committee on Immunization Practices; HPV = human papillomavirus; tetravalent meningococcal conjugate vaccine; Tdap = tetanus toxoid, reduced diphtheria toxoid, and pertussis vaccine; UTD = up to date.

https://www.cdc.gov/mmwr/volumes/67/wr/mm6733a1.htm

Genital Warts — Prevalence per 1000 Person-Years Among Participants in Private Health Plans Aged 10–39 Years by Sex, Age Group, and Year, 2003–2010

Results of selected clinical trials on human papillomavirus (HPV) vaccine efficacy against HPV vaccine-type precancers and anogenital warts

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Vaccine</th>
<th>Sex</th>
<th>Vaccine efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical precancer</td>
<td>Bivalent and quadrivalent</td>
<td>Females</td>
<td>&gt;93%</td>
</tr>
<tr>
<td>Vaginal/Vulvar precancer</td>
<td>Quadrivalent</td>
<td>Females</td>
<td>100%</td>
</tr>
<tr>
<td>Anal precancer</td>
<td>Quadrivalent</td>
<td>Males</td>
<td>75%</td>
</tr>
<tr>
<td>Anogenital warts</td>
<td>Quadrivalent</td>
<td>Females</td>
<td>99%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Males</td>
<td>80%</td>
</tr>
</tbody>
</table>

SEROGROUP B MENINGOCOCCAL VACCINE

NEISSERIA MENINGITIDIS

• Twelve known serogroups, six of which are responsible for invasive human disease.
  • A, B, C, W, X, and Y
• Although rare in the United States, invasive meningococcal disease (by any serogroup) is a serious illness and life-threatening.
  • Historically low incidence of 0.18 per 100,000
N. Meningitidis Vaccines

- Quadrivalent meningococcal conjugate vaccine
  - Prevention of serogroups A, C, W, Y
  - Routinely given to patients at age 11 years, with booster at age 16 years.
- Serogroup B meningococcal vaccine
  - MenB-FHbp (licensed in October 2014)
  - MenB-4C (licensed in January 2015)

Serogroup B Meningococcal Vaccine

**MenB-FHbp**
- Bivalent vaccine consisting of 2 different binding proteins from subfamilies A & B.
- Licensed for use in persons 10-25 years of age.
- Administered in a 2- or 3-dose series, depending on risk.

**MenB-4C**
- Multicomponent vaccine consisting of 3 recombinant proteins from N. meningitidis and an outer membrane vesicle.
- Licensed for use in persons 10-25 years of age.
- Administered in a 2-dose series, regardless of risk.
ACIP RECOMMENDATION #1

- February 26, 2015
  - Routine use of MenB vaccines for persons 10 years and older who are at increased risk of serogroup B meningococcal disease.
    - Persistent complement component deficiencies
    - Anatomic or functional asplenia, including sickle cell disease
    - Healthy persons at risk due to outbreak
  - Category A recommendation
    - Recommendations are made for all persons in an age- or risk-factor-based group
- May 19, 2017
  - For persons at increased risk for meningococcal disease, ACIP recommends that 3 doses of MenB-FHbp be administered at 0, 1–2, and 6 months.

ACIP RECOMMENDATION #2

- June 24, 2015
  - Permissive use of MenB vaccine in healthy adolescents and young adults from age 16-23 years of age (preferred ages, 16-18 years).
    - To provide short-term protection against most strains of MenB, although not at increased risk
  - No recommendation for routine immunization.
  - Category B recommendation
    - Recommendations are made for individual clinical decision making.
OTHER CONSIDERATIONS...

• College freshman (especially living in residence halls) and military recruits are at increased risk of invasive meningococcal disease due to serogroups in MCV4 vaccine.

• Initially, this was not shown to be true for serogroup B meningococcal disease.
  - Pediatrics, January 2019

• While the incidence of MenB disease in the US remains low, there is new evidence that shows college students (18-24yo) are 3x increased risk of non-college students of same age (0.17 vs 0.05 cases/100,000).

23-VALENT PNEUMOCOCCAL POLYSACCHARIDE VACCINE
**STREPTOCOCUS PNEUMONIAE**

- Extracellular pathogen that resists phagocytosis in the absence of antibody.
- Resides asymptptomatically in the nasopharynx of healthy carriers.
- Pneumococci are pathogenic in humans.
- 91 different serotypes of *S. pneumoniae*.
  - About 23 serotypes are responsible for 80-90% of invasive infections.

**PNEUMOCOCCAL DISEASE**

- **Invasive**
  - Associated with invasive strains.
  - Defined by involvement of major organs or presence of bloodstream infection.
  - Isolated in normally sterile biofluids.
    - Blood, CSF, Pleural Fluid, Peritoneal Fluid

- **Non-Invasive**
  - Less threatening.
  - Presents most commonly as:
    - Bronchitis
    - Otitis Media
    - Sinusitis
PNEUMOCOCCAL VACCINES

  - Covered 14 serotypes (PPV14)
- Improved vaccine approved in 1983.
  - Expanded to include 23 serotypes (PPV23)

- Pneumococcal conjugate vaccine developed for children in 2000.
  - Used 7 most common serotypes that caused invasive disease in children.
  - Expanded to include 13 serotypes in 2010.

PPSV23

- CDC & ACIP recommend PPSV23 immunization for all individuals who are at increased risk of invasive pneumococcal disease.
  - Individuals older than 65 years of age
  - Individuals with diabetes mellitus
  - Children (>2 years) and adolescents with certain underlying medical conditions.
### Table 3. Underlying Medical Conditions that Are Indications for Pneumococcal Vaccination

<table>
<thead>
<tr>
<th>Risk Group</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunocompetent children and teens with risk condition</td>
<td>Chronic heart disease (particularly cystic congenital heart disease and cardiac failure); chronic lung disease (including asthma if treated with prolonged high-dose oral corticosteroids); diabetes mellitus; cerebrospinal fluid leak; cochlear implant</td>
</tr>
</tbody>
</table>
| Children and teens with functional or anatomic asplenia | • Sickle cell disease and other hemoglobinopathies  
• Congenital or acquired asplenia, or splenic dysfunction |
| Children and teens with immunocompromising condition | • HIV infection  
• Chronic renal failure and nephrotic syndrome  
• Diseases associated with treatment with immunosuppressive drugs or radiation therapy (e.g., malignant neoplasms, leukemias, lymphomas, and Hodgkin disease; or solid organ transplantation)  
• Congenital immunodeficiency (includes B, [humoral] or T-lymphocyte deficiency; complement deficiencies, particularly C1, C2, C3, or C4 deficiency; and phagocytic disorders [excluding chronic granulomatous disease]) |


### Table 2. Recommended Schedule for Administering Pneumococcal Polysaccharide Vaccine (PPSV23)

<table>
<thead>
<tr>
<th>Risk Group</th>
<th>Schedule for PPSV23</th>
<th>Revaccination with PPSV23</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunocompetent children and teens with underlying medical condition (see Table 3 at right)</td>
<td>Give 1 dose of PPSV23 at age 2 years or older and at least 8 weeks after last dose of PCV13</td>
<td>Not indicated</td>
</tr>
<tr>
<td>Children and teens with immunocompromising condition, functional or anatomic asplenia (see specific conditions in Table 3 at right)</td>
<td>Give 1 dose of PPSV23 at age 2 years or older and at least 8 weeks after last dose of PCV13</td>
<td>Give 1 additional dose of PPSV23 at least 5 years following the first PPSV23; the next recommended dose would be at age 65 years</td>
</tr>
</tbody>
</table>

USING PCV13 WITH PPSV23

- ACIP recommends both PCV13 and PPSV23 be given to children with high-risk medical conditions. (Table 3, previous slide)
- PCV13 covers 84% and PPSV23 covers 92% of the serotypes that cause invasive pneumococcal disease.
  - Patients on immunosuppressive therapy have a greater than 10-fold risk of developing invasive disease.

PPSV23 & COCHLEAR IMPLANTS

- Children with cochlear implants are more likely to get bacterial meningitis than children without.
- CDC recommends these patients follow recommendations for pneumococcal vaccination that applies to high-risk groups.
PPSV23 & COCHLEAR IMPLANTS

- Recommendations for timing and type of vaccination may vary with age and previous vaccines.
- PPSV23 should be given to all patients with or candidates for cochlear implants.
  - Must be 2 years of age.
  - Must be at least 8 weeks after last PCV13 dose.
  - Ideally, should be at least 2 weeks prior to implantation.

INFLUENZA VACCINE
INFLUENZA VIRUS

- RNA virus, includes 6 genera
  - 3 genera of influenza virus that can infect humans
    - Influenza A, B, and (C)
    - Identified by antigenic differences in nucleoprotein and matrix protein

ANTIGENIC CHANGES

- Influenza A
  - Categorized into subtypes based on hemagglutinin and neuraminidase surface antigens.
  - New variants emerge due to point mutations and recombination events during viral replication.
  - Antigenic shifts

- Influenza B
  - Separated into two distinct genetic lineages (Yamagata, Victoria).
  - Undergo antigenic drift less frequently than Flu A.
  - Co-circulate during most influenza seasons.

- (Influenza C)
  - No capability of antigenic shift.
  - No significant threat to human health, no vaccine.
BURDEN OF INFLUENZA DISEASE

- Annual epidemics of seasonal influenza.
  - Onset, peak, and end of activity varies
  - Typically occurs between October and April in U.S.
- Most infected persons recover without sequelae.
  - Symptoms include fever, cough, sore throat, myalgia, fatigue
- Can cause serious illness and death, particularly in high risk groups.
  - Older adults (>65 years), young children (<5 years), pregnant women, individuals with chronic medical conditions
INFLUENZA ILLNESS & CHILDREN

• Influenza-associated hospitalizations are substantially higher among infants and children less than 5 years old.

<p>| TABLE 1: Pediatric Deaths and Hospitalizations by Season and Predominant Strain |
|---------------------------------|----------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Influenza Season</th>
<th>Predominant Strain</th>
<th>Pediatric Deaths, n</th>
<th>Hospitalizations, per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015-2016 (preliminary data)</td>
<td>H1N1</td>
<td>85</td>
<td>42.5</td>
</tr>
<tr>
<td>2014-2016</td>
<td>H3N2</td>
<td>148</td>
<td>52.3</td>
</tr>
<tr>
<td>2013-2014</td>
<td>pH1N1</td>
<td>111</td>
<td>47.3</td>
</tr>
<tr>
<td>2012-2013</td>
<td>H3N2</td>
<td>171</td>
<td>67</td>
</tr>
<tr>
<td>2011-2012</td>
<td>H1N1</td>
<td>37</td>
<td>10</td>
</tr>
<tr>
<td>2010-2011</td>
<td>H3N2</td>
<td>123</td>
<td>48.5</td>
</tr>
<tr>
<td>2009-2010</td>
<td>pH1N1</td>
<td>288</td>
<td>77.4</td>
</tr>
<tr>
<td>2008-2009</td>
<td>H1N1</td>
<td>137</td>
<td>28</td>
</tr>
<tr>
<td>2007-2008</td>
<td>H3N2</td>
<td>88</td>
<td>46.3</td>
</tr>
<tr>
<td>2006-2007</td>
<td>H1N1</td>
<td>77</td>
<td>56.6</td>
</tr>
</tbody>
</table>

*Vaccine strains did not change from previous influenza season.

INFLUENZA VACCINE

• Available in multiple forms
  • IIV3: trivalent inactivated influenza vaccine
  • IIV4: quadrivalent inactivated influenza vaccine
  • LAIV: live attenuated influenza vaccine
INACTIVATED INFLUENZA VACCINE

- Trivalent
  - Intramuscular injection
  - Includes 2 subtypes of influenza A and 1 lineage of influenza B.
    - Predicted to be predominant strains

- Quadrivalent
  - Intramuscular injection
  - Contain the other lineage of influenza B as well.

LIVE ATTENUATED INFLUENZA VIRUS

- Poor effectiveness against in most recent seasons, particularly against influenza A.

- No statistically significant benefit shown in any pediatric age group for past 3 seasons.
UPDATED AAP RECOMMENDATION

- For the 2016-17 and 2017-18 influenza seasons, the CDC’s Advisory Committee on Immunization Practices (ACIP) made the interim recommendation that LAIV should not be used in any setting.

- For the 2018-19 influenza season, the ACIP made the recommendation for the use of LAIV as an option for anyone in whom it is appropriate. However, no effectiveness estimates are available for this new formulation of LAIV.
  - Based on the currently available data, the American Academy of Pediatrics recommends the use of IIV for all children and adolescents.

OTHER CONSIDERATIONS FOR INFLUENZA SEASON (UNCHANGED)

- AAP recommends annual seasonal influenza immunization for everyone 6 months and older.
- No preference is given to either IIV3 or IIV4.
  - Providers should give any available formulation
- Number of doses of influenza vaccine is based on age and vaccination history.
  - <6 months: no licensed vaccines
  - ≥9 years: 1 dose
  - 6mo-8yr: require 2 doses in current or past influenza season, separated by at least 4 weeks
    - Previous doses do not need to be in the same or consecutive seasons
INFLUENZA VACCINES & EGG ALLERGY

• Most IIV vaccines are produced in eggs and contain measurable amounts of egg protein.
• Recent data have shown that when administered in age-appropriate doses, IIV is well-tolerated by recipients with a history of egg allergy of any severity.
  • Even in patients with history of severe egg allergy, no increased risk of anaphylaxis from influenza vaccine.
  • 1 case per 1,000,000 doses
    • No different from other vaccines (with or without egg)

Influenza vaccination coverage estimates for persons 6 months and older by State, HHS Region, and the United States, National Immunization Survey-Flu (NIS-Flu) and Behavioral Risk Factor Surveillance System (BRFSS), 2017-18 influenza season

VACCINE EXEMPTION & DELAY

- Strong evidence that skipping or delaying vaccines increases a child’s risk of acquiring vaccine-preventable diseases.
- Statement from the American Academy of Pediatrics:
  - “There is no ‘alternative’ immunization schedule. Delaying vaccines only leaves a child at risk of disease for a longer period of time; it does not make vaccinating safer.”

ARIZONA FLU VACCINE RATES

<table>
<thead>
<tr>
<th>Age</th>
<th>Arizona</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6 months</td>
<td>12,285</td>
<td>435,204</td>
</tr>
<tr>
<td>6 months - 17 years</td>
<td>2,358</td>
<td>121,041</td>
</tr>
<tr>
<td>6 months - 4 years</td>
<td>740</td>
<td>39,205</td>
</tr>
<tr>
<td>5-12 years</td>
<td>1,120</td>
<td>52,222</td>
</tr>
<tr>
<td>13-17 years</td>
<td>498</td>
<td>31,533</td>
</tr>
</tbody>
</table>

Source: https://www.cdc.gov/flu/flu_vaxview/reportshtml/reporti1718/reportii/index.html

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REFERENCES

QUESTIONS?