Conflict of Interest

- Dr. Middleton serves as a physician consultant on vaccines to Merck & Co Inc., Pfizer, GlaxoSmithKline, and Sanofi Pasteur
- Dr. Zimmerman has research grants from Pfizer Inc, Merck & Co Inc, and Sanofi Pasteur
Adult Immunizations 2017

- 6 routine diseases requiring vaccination
  - Pertussis
  - Diphtheria
  - Tetanus
  - Zoster
  - Pneumococcus (13/23=24 serogroups)
  - Influenza (3 or 4 strains)

- Special circumstance vaccinations
  - Measles
  - Mumps
  - Rubella
  - Varicella
  - Hib
  - HPV: 9 types
  - Meningococcal: 4 serogroups: ACWY and 5th serogroup B
  - Hepatitis B
  - Hepatitis A

- Ultra special vaccines:
  - Travel: polio, yellow fever, cholera, BCG (tuberculosis), Japanese encephalitis, typhoid
  - Potential exposure: smallpox, adenovirus (type 4 and 7), rabies, anthrax
Changes to the 2017 Schedule

• Removal of LAIV
• Egg allergy resulting in hives: vaccinate
• Egg allergy resulting in more than hives: use RIV or IIV in a medical setting with provider who can manage severe allergy
• 9vHPV vaccine only HPV vaccine in use
• Hepatitis B vaccine indication expanded to those with ALT or AST twice the upper limit of normal
• Multiple meningococcal vaccine changes (quadrivalent ACWY and B)
Recommended Immunization Schedule for Adults Aged 19 Years or Older, United States, 2017

In February 2017, the Recommended Immunization Schedule for Adults Aged 19 Years or Older, United States, 2017 became effective, as recommended by the Advisory Committee on Immunization Practices (ACIP) and approved by the Centers for Disease Control and Prevention (CDC). The 2017 adult immunization schedule was also reviewed and approved by the following professional medical organizations:

- American College of Physicians (www.acponline.org)
- American Academy of Family Physicians (www.aafp.org)
- American College of Obstetricians and Gynecologists (www.acog.org)
- American College of Nurse-Midwives (www.midwife.org)


The adult immunization schedule describes the age groups and medical conditions and other indications for which licensed vaccines are recommended. The 2017 adult immunization schedule consists of:

- Figure 1. Recommended immunization schedule for adults by age group
- Figure 2. Recommended immunization schedule for adults by medical condition and other indications
- Footnotes that accompany each vaccine containing important general information and considerations for special populations
- Table. Contraindications and precautions for vaccines routinely recommended for adults

Consider the following information when reviewing the adult immunization schedule:

- The figures in the adult immunization schedule should be read with the footnotes that contain important general information and information about vaccines for special populations.
- When indicated, administer recommended vaccines to adults whose vaccination history is incomplete or unknown.
- Rare events in large populations do not necessarily indicate vaccine-associated adverse events.
- Combination vaccines may be used when any component of the combination is indicated and when the other components of the combination vaccine are not contraindicated.
- The use of trade names in the adult immunization schedule is for identification purposes only and does not imply endorsement by the ACIP or CDC.

Details on vaccines recommended for adults and complete ACIP statements are available at www.cdc.gov/vaccines/hcp/acip-recs/index.html. Additional CDC resources include:

- A summary of information on vaccination recommendations, vaccination of persons with immunodeficiencies, preventing and managing adverse reactions, vaccination contraindications and precautions, and other information can be found in General Recommendations on Immunization at www.cdc.gov/mmwr/preview/mmwrhtml/m6002a1.htm.

Vaccine Information Statements that explain benefits and risks of vaccines are available at www.cdc.gov/vaccines/hcp/safety/vaccine-information-statements.html.

Information and resources regarding vaccination of pregnant women are available at www.cdc.gov/vaccines/hcp/pregnancy/vaccine-safety.html.

Information on travel vaccine requirements and recommendations is available at www.cdc.gov/travel/destinations/list.

CDC Vaccine Schedules App for clinicians and other immunization service providers to download is available at www.cdc.gov/vaccines/schedules/hcp/schedule-app.html.

Recommended Immunization Schedule for Children and Adolescents Aged 18 Years or Younger is available at www.cdc.gov/vaccines/schedules/hcp/child桌子.html.

Report suspected cases of reportable vaccine-preventable diseases to the local or state health department.

Report all clinically significant post-vaccination reactions to the Vaccine Adverse Event Reporting System at www.vaers.hhs.gov or by telephone, 800-232-2797. All vaccines included in the 2017 adult immunization schedule except herpes zoster and 23-valent pneumococcal polysaccharide vaccines are covered by the Vaccine Injury Compensation Program. Information on how to file a vaccine injury claim is available at www.hrsa.gov/vaccinecompensation or by telephone, 800-338-2382.

Submit questions and comments regarding the 2017 adult immunization schedule to CDC through www.cdc.gov/cdc-info or by telephone, 800-CDC-INFO (800-232-4636), in English and Spanish, 8:00am–8:00pm ET, Monday–Friday, excluding holidays.

The following acronyms are used for vaccines recommended for adults:

- HepA: Hepatitis A vaccine
- HepB: Hepatitis B vaccine
- Hib: Haemophilus influenzae type b conjugate vaccine
- HPV vaccine: Human papillomavirus vaccine
- HZV: Herpes zoster vaccine
- IIV: Inactivated influenza vaccine
- LAIV: Live attenuated influenza vaccine
- MenACWY: Serogroups A, C, W, and Y meningococcal conjugate vaccine
- MenB: Serogroup B meningococcal vaccine
- MMR: Measles, mumps, and rubella vaccine
- MPSV4: Serogroups A, C, W, and Y meningococcal polysaccharide vaccine
- PCV13: 13-valent pneumococcal conjugate vaccine
- PPSV23: 23-valent pneumococcal polysaccharide vaccine
- RIV: Recombinant influenza vaccine
- Td: Tetanus and diphtheria toxoids
- Tdap: Tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine
- Var: Varicella vaccine

1. MMWR Morb Mortal Wkly Rep. 2017;66(5). Available at www.cdc.gov/mmwr/volumes/66/wr/mm6605e2.htm?s_cid=mm6605e2_w.
Figures 1 and 2 should be read with the footnotes that contain important general information and considerations for special populations.

**Figure 1. Recommended immunization schedule for adults aged 19 years or older by age group, United States, 2017**

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>19–21 years</th>
<th>22–26 years</th>
<th>27–59 years</th>
<th>60–64 years</th>
<th>≥ 65 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza(^1)</td>
<td></td>
<td></td>
<td>1 dose annually</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Td/Tdap(^2)</td>
<td></td>
<td></td>
<td>Substitute Tdap for Td once, then Td booster every 10 yrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMR(^3)</td>
<td></td>
<td></td>
<td>1 or 2 doses depending on indication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAR(^4)</td>
<td></td>
<td></td>
<td></td>
<td>2 doses</td>
<td></td>
</tr>
<tr>
<td>HZV(^5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 dose</td>
</tr>
<tr>
<td>HPV–Female(^6)</td>
<td></td>
<td></td>
<td>3 doses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HPV–Male(^6)</td>
<td></td>
<td></td>
<td></td>
<td>3 doses</td>
<td></td>
</tr>
<tr>
<td>PCV13(^7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 dose</td>
</tr>
<tr>
<td>PPSV23(^7)</td>
<td></td>
<td></td>
<td>1 or 2 doses depending on indication</td>
<td>1 dose</td>
<td></td>
</tr>
<tr>
<td>HepA(^8)</td>
<td></td>
<td></td>
<td></td>
<td>2 or 3 doses depending on vaccine</td>
<td></td>
</tr>
<tr>
<td>HepB(^9)</td>
<td></td>
<td></td>
<td></td>
<td>3 doses</td>
<td></td>
</tr>
<tr>
<td>MenACWY or MPSV(^10)</td>
<td></td>
<td></td>
<td></td>
<td>1 or more doses depending on indication</td>
<td></td>
</tr>
<tr>
<td>MenB(^10)</td>
<td></td>
<td></td>
<td></td>
<td>2 or 3 doses depending on vaccine</td>
<td></td>
</tr>
<tr>
<td>Hib(^11)</td>
<td></td>
<td></td>
<td></td>
<td>1 or 3 doses depending on indication</td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- **Yellow**: Recommended for adults who meet the age requirement, lack documentation of vaccination, or lack evidence of past infection
- **Purple**: Recommended for adults with additional medical conditions or other indications
- **White**: No recommendation
<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Pregnancy</th>
<th>Immuno-compromised (excluding HIV infection)</th>
<th>HIV infection CD4+ count (cells/μL)</th>
<th>Asplenia, persistent complement deficiencies</th>
<th>Kidney failure, end-stage renal disease, on hemodialysis</th>
<th>Heart or lung disease, chronic alcoholism</th>
<th>Chronic liver disease</th>
<th>Diabetes</th>
<th>Healthcare personnel</th>
<th>Men who have sex with men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Td/Tdap</td>
<td>1 dose Tdap each pregnancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMR</td>
<td>contraindicated</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAR</td>
<td>contraindicated</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>HZV</td>
<td>contraindicated</td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HPV—Female</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HPV—Male</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCV13</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>PPSV23</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HepA</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HepB</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MenACWY or MPSV4</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>MenB</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hib</td>
<td>3 doses post-HSCT recipients only</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Recommended for adults who meet the age requirement, lack documentation of vaccination, or lack evidence of past infection**
- **Recommended for adults with additional medical conditions or other indications**
- **Contraindicated**
- **No recommendation**
Table. Contraindications and precautions for vaccines recommended for adults aged 19 years or older*

The Advisory Committee on Immunization Practices (ACIP) recommendations and package inserts for vaccines provide information on contraindications and precautions related to vaccines. Contraindications are conditions that increase chances of a serious adverse reaction in vaccine recipients and the vaccine should not be administered when a contraindication is present. Precautions should be reviewed for potential risks and benefits for vaccine recipient. For a person with a severe allergy to latex, e.g., anaphylaxis, vaccines supplied in vials or syringes that contain natural rubber latex should not be administered unless the benefit of vaccination clearly outweighs the risk for a potential allergic reaction. For latex allergies other than anaphylaxis, vaccines supplied in vials or syringes that contain dry, natural rubber or natural rubber latex may be administered.

Contraindications and precautions for vaccines recommended for adults

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Contraindications</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>All vaccines routinely recommended for adults</td>
<td>Severe reaction, e.g., anaphylaxis, after a previous dose or to a vaccine component</td>
<td>Moderate or severe acute illness with or without fever</td>
</tr>
</tbody>
</table>

Additional contraindications and precautions for vaccines routinely recommended for adults

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Additional Contraindications</th>
<th>Additional Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVl</td>
<td>Severe immunodeficiency, e.g., hematologic and solid tumors, chemotherapy, congenital immunodeficiency or long-term immunosuppressive therapy; human immunodeficiency virus (HIV) infection with severe immunocompromise; pregnancy</td>
<td>History of Guillain-Barré Syndrome within 6 weeks after previous influenza vaccination; egg allergy other than hives, e.g., angioedema, respiratory distress, lightheadedness, or recurrent emesis; or required epinephrine or another emergency medical intervention. IVl may be administered in an inpatient or outpatient medical setting and under the supervision of a healthcare provider who is able to recognize and manage severe allergic conditions.</td>
</tr>
<tr>
<td>RIV</td>
<td>LAV should not be used during 2016–2017 influenza season</td>
<td>History of Guillain-Barré Syndrome within 6 weeks after previous influenza vaccination.</td>
</tr>
<tr>
<td>Tdap/Td</td>
<td>For pertussis-containing vaccines: encephalopathy, e.g., coma, decreased level of consciousness, or prolonged seizures, not attributable to another identifiable cause within 7 days of administration of a previous dose of a vaccine containing tetanus or diphtheria toxoid or acellular pertussis toxoid</td>
<td>History of Artus-type hypersensitivity reactions after a previous dose of tetanus or diphtheria toxoid-containing vaccine. Defer vaccination until at least 10 years have elapsed since the last tetanus toxoid-containing vaccine. For pertussis-containing vaccine, progressive or unstable neurologic disorder, uncontrolled seizures, or progressive encephalopathy (until a treatment regimen has been established and the condition has stabilized).</td>
</tr>
<tr>
<td>MMR</td>
<td>Severe immunodeficiency, e.g., hematologic and solid tumors, chemotherapy, congenital immunodeficiency or long-term immunosuppressive therapy; HIV infection with severe immunocompromise; pregnancy</td>
<td>Recent (within 11 months) receipt of antibody-containing blood product (specific interval depends on product); history of thrombocytopenia or thrombocytopenic purpura; need for tuberculin skin testing.</td>
</tr>
<tr>
<td>VAR</td>
<td>Severe immunodeficiency, e.g., hematologic and solid tumors, chemotherapy, congenital immunodeficiency or long-term immunosuppressive therapy; HIV infection with severe immunocompromise; pregnancy</td>
<td>Recent (within 11 months) receipt of antibody-containing blood product (specific interval depends on product); receipt of specific antiviral drugs (acyclovir, famciclovir, or valacyclovir) 48 hours before vaccination (avoid use of these antiviral drugs for 14 days after vaccination).</td>
</tr>
<tr>
<td>HZV</td>
<td>Severe immunodeficiency, e.g., hematologic and solid tumors, chemotherapy, congenital immunodeficiency or long-term immunosuppressive therapy; HIV infection with severe immunocompromise; pregnancy</td>
<td>Receipt of specific antiviral drugs (acyclovir, famciclovir, or valacyclovir) 48 hours before vaccination (avoid use of these antiviral drugs for 14 days after vaccination).</td>
</tr>
<tr>
<td>HPV vaccine</td>
<td>Severe or severe allergic reaction to any vaccine containing diphtheria toxoid</td>
<td>Pregnancy</td>
</tr>
<tr>
<td>PCV13</td>
<td>Severe allergic reaction to any vaccine containing diphtheria toxoid</td>
<td></td>
</tr>
</tbody>
</table>

2. MMR may not be administered together with VAR or HZV on the same day. If not administered on the same day, separate live vaccines by at least 28 days.
3. Immunosuppressive steroid dose is considered to be daily receipt of 20 mg or more prednisone or equivalent for two or more weeks. Vaccination should be deferred for at least 1 month after discontinuation of immunosuppressive steroid therapy. Providers should consult ACIP recommendations for complete information on the use of specific live vaccines among persons on immune-suppressing medications or with immune suppression because of other reasons.
4. Vaccine should be deferred for the appropriate interval if replacement immune globulin products are being administered. See: CDC. General recommendations on immunization: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 2011;60(No. RR-2): Available at www.cdc.gov/mmwr/preview/mmwrhtml/rr6002a1.htm.
5. Measles vaccination may temporarily suppress tuberculin reactivity. Measles-containing vaccine may be administered on the same day as tuberculin skin testing, or should be postponed for at least 4 weeks after vaccination.


Acronyms of vaccines recommended for adults

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HepA</td>
<td>Hepatitis A vaccine</td>
</tr>
<tr>
<td>HepA-HepB</td>
<td>Hepatitis A and hepatitis B vaccines</td>
</tr>
<tr>
<td>HepB</td>
<td>Hepatitis B vaccine</td>
</tr>
<tr>
<td>Hib</td>
<td>Hemophilus influenza type b conjugate vaccine</td>
</tr>
<tr>
<td>HPV</td>
<td>Human papillomavirus vaccine</td>
</tr>
<tr>
<td>IIV</td>
<td>Inactivated influenza vaccine</td>
</tr>
<tr>
<td>LAIV</td>
<td>Live attenuated influenza vaccine</td>
</tr>
<tr>
<td>MenACWY</td>
<td>Serogroups A, C, W, and Y meningococcal conjugate vaccine</td>
</tr>
<tr>
<td>MenB</td>
<td>Serogroup B meningococcal vaccine</td>
</tr>
<tr>
<td>MMR</td>
<td>Mumps, measles, and rubella vaccine</td>
</tr>
<tr>
<td>MPSV4</td>
<td>Serogroups A, C, W, and Y meningococcal polysaccharide vaccine</td>
</tr>
<tr>
<td>PCV13</td>
<td>13-valent pneumococcal conjugate vaccine</td>
</tr>
<tr>
<td>PPSV23</td>
<td>23-valent pneumococcal polysaccharide vaccine</td>
</tr>
<tr>
<td>RIV</td>
<td>Recombinant influenza virus</td>
</tr>
<tr>
<td>Td</td>
<td>Tetanus and diphtheria toxoids</td>
</tr>
<tr>
<td>Tdap</td>
<td>Tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine</td>
</tr>
</tbody>
</table>
Immunocompromised Host

- Killed vaccines are indicated because risk of disease is increased but they may not induce as great an immunologic response as in healthy persons.
- Timing of vaccination may be specific: e.g., 6 months after stem cell transplant.
- Live vaccines are generally contraindicated; HIV has CD4+ count cut off of 200 cells for MMR
- When given inadvertently, e.g., Varivax (live) to HIV patients, few if any consequences reported.

Physician and Public Perceptions about Vaccine-Preventable Diseases Misconceptions/Truths

- **Misconceptions:**
  - Vaccine-preventable diseases (VPDs) are gone: Most have never seen majority of VPDs. Indeed some are gone: smallpox and polio types 3 and 2
  - Vaccine adverse effects are serious and long-lasting

- **Truths:**
  - Vaccines are almost totally safe
  - VPDs are STILL AROUND
    - Influenza
    - Pneumococcal pneumonia and invasive disease
    - Pertussis
    - HPV
    - Herpes zoster
  - Role of outbreaks: measles, mumps, etc.
Mumps Outbreaks

- Currently in hockey players
2014 Adult Vaccination Rates

- Pneumococcus: high-risk = 20.3%; ≥65 yrs = 61.3%
- Influenza: 43.2%; HCW = 66%
- Td: ≥19 yrs = 62.2%; ≥65 yrs = 55%
- Tdap: ≥19 yrs = 20.1%
- Shingles: ≥60 yrs = 27.9%
- Hepatitis A: ≥19 yrs = 9%
- Hepatitis B: ≥19 yrs = 24.5%; HCW = 65%
- HPV: women 19-26 yrs = 40.2% ≥1 dose; men 19-21 yrs = 8.2% ≥1 dose
- “Largely unchanged from 2013”

MMWR, 2016;65:1-36
“Missed opportunities” = low vaccination rates

- Primary care medical records over 3.25 yrs., missed opportunities at medical visits:
  - 3.4 times for influenza vaccine
  - 10.7 times for PPV
  - 10.8 times for tetanus toxoid

  *J Am Board Fam Pract* 2005;18: 20-7

- Chronic/Acute care visits done without needed vaccinations

- Remedies:
  - Standing orders (78%)
  - Vaccinate at beginning of visit
  - Office champion
  - EHR reminders
  - Recall systems: calls or postcards
  - Chart reviews
  - Report cards
  - Economic reward
  - Free vaccine
  - Firm provider recommendation

*Vaccine* 2004; 22:3457-63

PPV = pneumococcal vaccine
The Solution: 4 Pillars Program
ABFM Part 4 Practice Improvement
Credit Available

www.4PillarsTransformation.pitt.edu
General Rules for Vaccination

• All shots count for all time.
  o Thus, an adult given one chickenpox vaccine as a child who comes in at age 40 years to get a chickenpox vaccine would be getting the second dose and completing the 2-dose series. Exceptions to this rule include rabies vaccine which has a maximal 3-day delay or oral typhoid vaccine which has no acceptable delay from the schedule.

• A 4-day grace period is allowed for early administration of most immunizations.
  o Thus a child given an MMR at age 361 days has been adequately vaccinated while a child given an MMR at age 360 days has not.

• Frozen vaccines (Varivax and Zostavax) must be administered within 30 minutes of reconstitution.

• Vaccine diluents can be kept at room temperature and should not be frozen.

• Vaccines administered inadvertently in the buttocks must be repeated.

An office vaccine champion who is familiar with general vaccination rules will reduce errors.
Annual Flu Epidemic

- **Prevention:**
  - Hygiene
  - Vaccine
  - Antiviral drugs

- **Treatment:**
  - Supportive care
  - Antiviral drugs
  - Respirators/ECMO
Influenza: An Annual Epidemic

• 5%-20% of the US population becomes ill with influenza each year (subclinical or mild cases difficult to identify)
  o 15-60 million cases overall

• 3000-49,000: Estimated annual influenza-related deaths (attributed to flu or flu complications) in US; link to MI, stroke

• 250,000-500,000 deaths world wide

• Influenza and pneumonia: Eighth leading cause of death in the US (all ages)

• 55,000-431,000: Range of estimated annual influenza-related hospitalizations in US

• 90% of hospitalized adults have underlying health condition

MMWR 2017; 66:159-166
https://www.cdc.gov/mmwr/volumes/66/wr/mm6606a2.htm?s_cid=mm6606a2_w
Older Adults: High Disease Burden

- Older adults represent 13.7% of the US population
- But 63% of influenza-related hospitalizations
- And >90% of influenza-related deaths: most due to type A strains
- Influenza and pneumonia: No. 7 cause of death in the US in persons ≥65 years of age
- Vaccination rates for seniors have hovered in the 65%-70% range for a decade
- Despite having the highest vaccination rate, seniors have the highest complication rate
Influenza-related Hospitalizations and Deaths


Influenza and Comorbidities

- Influenza may lead to hospitalization or death from other causes, such as heart failure, myocardial infarction, stroke, or respiratory collapse.
- Influenza causes complications like pneumonia, sepsis, sinusitis, otitis media.
- The pivotal contributing role of influenza in these clinical consequences is often unrecognized.
- Age itself is a comorbidity: immunosenescence: lower antibody levels post-vaccination.
- Medications may interfere with response to flu vaccine: statins and flu vaccine.
  - J Infect Dis (2016) 214 (8): 1150-1158
Challenges with Flu Virus & Vaccines

- Antigenic drift and shift in circulating flu viruses
- Vaccine match missed due to evolving flu strains
- Overcrowding and poor hygiene:
  - higher viral load exposure?
- Poor immune response: older age or immunocompromise
- High-risk medical conditions; anatomic issues; smoking
- One answer for $>65$ years:
  - high-dose (antigen) vaccine induces higher antibody titers than regular-dose vaccine
  - reduces lab-confirmed influenza by 24% (NNTV= 220)
    NEJM 2014;371(7):635-645
- Adjuvanted (MF59) is another option for those $>65$ years
Estimates of Flu Vaccine Effectiveness (VE) 2016-2017

• Against influenza A and influenza B virus infection associated with medically attended ARI was 48% (95% confidence interval [CI] = 37%–57%)

• Most influenza infections were caused by A (H3N2) viruses.

• VE estimated to be 43% (CI = 29%–54%) against illness caused by influenza A (H3N2) virus and 73% (CI = 54%–84%) against influenza B virus.

• High dose may be more effective for seniors: 2017 report of 24% effective in reducing mortality
  (J Infect Dis jiw641. DOI:https://doi.org/10.1093/infdis/jiw641)

• VE for hospitalization, death under study now
  MMWR, 2017; 66:167-171

https://www.cdc.gov/mmwr/volumes/66/wr/mm6606a3.htm?s_cid=mm6606a3_w
Vaccine Types

• Inactivated inactivated influenza vaccine (IIV): subvirion or purified surface antigen preparations
  o Older whole-inactivated product off the market; higher reaction rates
  o Intradermal form with micro-needle
  o One brand (Afluria) by jet injector (needle-free)
• Recombinant Vaccine (Flublok) – can use if severe egg allergy as no egg; expensive
• Cell culture derived
• Adjuvanted IIV for ≥65 (Fluad; MF59 adjuvant, trivalent)
• High dose IIV for ≥65 (Fluzone High Dose, 4X normal antigen dose, trivalent)

  Live attenuated influenza vaccine (LAIV) – not to be used in 2017
# Influenza vaccine options for adults by age

<table>
<thead>
<tr>
<th>Age group in years</th>
<th>IIV</th>
<th>IIV Intra-dermal</th>
<th>RIV for egg allergic</th>
<th>Cell-culture IIV</th>
<th>LAIV</th>
<th>IIV High Dose or Adjuvanted IIV</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-49</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>50-64</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>≥65</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

RIV = FluBlok  
Cell-culture = Flucelvax
Contraindications and Side Effects

- Anaphylaxis to eggs or vaccine component: use RIV
- Persons who experience only hives with exposure to eggs may receive RIV or, with additional safety precautions, IIV
- Side effects: local and systemic; pain, swelling, nasal congestion; fainting
- Precautions:
  - Guillain-Barré syndrome within 6 weeks of previous dose
  - Moderate or severe illness with/without fever
- Do NOT use LAIV
Month of Peak Influenza Activity – United States, 1976-2002

- Dec: 15%
- Jan: 23%
- Feb: 42%
- Mar: 12%
- Apr: 4%
- May: 4%
H7N9 Avian Flu in China

- During the first four epidemics:
  - 88% developed pneumonia,
  - 68% admitted to ICU, and
  - 41% died

- Fifth epidemic – started October 2016
  - Largest so far: 460 cases
  - Limited human-to-human spread
  - Mostly associated with poultry exposure
  - Reduced coverage by existing candidate vaccine viruses so new vaccine candidates will need to be made
Pneumococcus
Both PCV13 and PPSV23

- PPSV23 stops invasive disease but probably does not significantly influence the risk of pneumonia. PPSV23’s protective effect wanes at some point in the future, probably 5 to 7 years.

- PCV13 reduces the risk of pneumonia by 48% and invasive disease by 75%. The duration of PCV13’s protective effect is unknown but may be lifelong.

- Preferentially PCV13 should be administered first because of improved T cell response.

- For immunocompromised individuals PPSV23 should be given ≥8 weeks following PCV13 to extend protection against invasive disease.

- For persons age ≥65 years PPSV23 should be given one year after PCV13 although any time length between the 2 vaccines does not require revaccination.
Both PCV13 and PPSV23

• If PPSV23 is given first, PCV13 should follow ≥1 year later.
• Persons with chronic diseases such as diabetes mellitus or COPD do not need PCV13, only PPSV23 unless they are age ≥65 years.
• For persons with immunocompromising conditions, PPSV23 should be readministered once 5 years later and once again after age ≥65 years if the second dose was administered at age <65 years. The minimal interval between doses of PPSV23 is 5 years. The maximal number of PPSV23 doses lifetime is 3. No further doses are indicated after the age ≥65-year dose.
• For adults the maximal number of PCV13 doses is one.
## Medical conditions indicating PCV13 or PPSV23

<table>
<thead>
<tr>
<th>Risk group</th>
<th>Underlying medical condition</th>
<th>PCV</th>
<th>PPSV</th>
<th>PPSV revaccination 5 years after 1st PPSV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immunocompetent high-risk</td>
<td>Chronic heart, lung (asthma/COPD), or liver; DM, alcoholism, smoker</td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CSF leak, cochlear implant</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Asplenia</td>
<td>Sickle cell, hemoglobinopathy, asplenia</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Immunocompromised</td>
<td>HIV, cancer, radiation, leukemia, myeloma, solid organ transplant, long-term steroids, CRF</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
HPV: Recognized HPV-Related Cancers
Annual US Burden: HPV9 covers 60-90%

- Cervical cancer: 95% = 10,400 cases
- Anal cancer: 90% = 4,000 cases
- Penile cancer: 60% = 700 cases
- Vulvar cancer: 75% = 2,000 cases
- Vaginal cancer: 70% = 600 cases
- Oropharyngeal: 70% = 9,000 cases
- Prevents genital warts and abnormal Pap smears

http://www.cdc.gov/cancer/hpv/
## Serogroup C Meningococcal Disease Clusters/Outbreaks Among Men Who Have Sex With Men, 2010-2017

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Outbreak Period</th>
<th>Number of cases (deaths) among MSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York City</td>
<td>Aug 2010 – Feb 2013</td>
<td>22 (7)</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>Oct 2012 - Sep 2014</td>
<td>10 (4)</td>
</tr>
<tr>
<td>Chicago*</td>
<td>June 2015 – Sep 2016</td>
<td>11 (1)*</td>
</tr>
<tr>
<td>Southern California</td>
<td>Mar – Sep 2016</td>
<td>21 (2)</td>
</tr>
<tr>
<td>Miami</td>
<td>Sep 2016 – Jan 2017</td>
<td>3 (1)</td>
</tr>
</tbody>
</table>

* Includes one case identified among a resident of a different state who had close links to Chicago.

MenACWY vaccination
Meningococcal Vaccines

- **Asplenia:** vaccinate with both MenACWY and MenB
  - 2 dose Men ACWY primary series 2 months apart then every 5 years
- **HIV:** vaccinate all with MenACWY, 2 dose primary series but NOT MenB
- **To control outbreaks:**
  - **Outbreak:** 3 or more cases of disease in same area in ≤3 months among persons who are not contacts of each other with an attack rate of ≥10 per 100,000 population.
  - Both MPSV4 (preferred age ≥56 years) and MenACWY (preferred age <56 years) recommended for outbreaks caused by vaccine-preventable serogroups (A, C, W, Y).
- **Meningococcus B:** Persons age ≥10 years at increased risk because of serogroup B meningococcal outbreak, e.g., on college campuses, should be given 3-dose series of MenB-FHbp (Trumenba) at time 0, 1-2, and 6 months or 2-dose series of Men-4C (Bexsero) at time 0 and 1 month. MenB vaccines are NOT interchangeable; the same vaccine product must be used for all doses. Adult teaching and support are included regardless of age, no real upper limit.
Meningococcal vaccines

- Trumenba = MenB-FHbp
  - FDA-approved age 10-25 years
  - 3 doses at 0, 1-2, 6 months at adults at increased risk and outbreaks
  - 2 doses at 0, 6 months for healthy adolescents and young adults (e.g., college students; preferred ages 16-18 years)

- Bexsero = MenB-4C (4 component)
  - FDA-approved age 10-25 years
  - 2 doses at least 1 month apart

During outbreaks for control no upper age limit
Vaccines for the Liver
Hepatitis A & B Vaccines

Vaccinate those who are adopted internationally
Salads and fruits: hepatitis A
Liver disease: cirrhosis, alcoholism
Diabetes mellitus: ≤59 yrs. routine; 60 and over elective

ALT/AST 2* ULN

Vaccines:
Hepatitis A: 0, 6 mos
Hepatitis B: 0, 1, 6 mos
Twinrix (A+B): 0, 1, 6 mos

Must give all 3 doses to cover both hep A +B.
Herpes zoster: Chickenpox & Shingles

More dangerous in adults
Lasting consequences

NEJM 2010:362: 1128,1227
**Shingles vaccine:** 1 dose: give within 30 mins.

- No need to take history of past chicken pox or shingles
- No need to give chickenpox vaccine first but you can if no CP history, 2 doses 4 weeks apart
- When to give: age ≥50 years vs age ≥60 years
- Role of the pharmacist: age ≥65 yrs.
- Concomitant use with PPSV23/ PCV13 okay
- Use with immunocompromised person in the household okay
- Use after personal history of zoster (shingles): may give (+/- benefit) in 1 year or wait at least five years; recurrence rate 6% within 5 yrs. time; benefit may be better after that
- Standing order increases vaccination rate
- Contraindications: pregnancy, immune deficiency (HIV), chronic steroid use; cancer, chemotherapy, radiation therapy
Tdap 2017 Reminders

• Tdap use expanded: now for anyone; one lifetime dose unless pregnant

• Tdap for each pregnancy regardless of prior vaccination status; preferred at weeks 27-36 gestation; earlier better

• No interval necessary between Td and Tdap

• No upper age limit

• Over age 65 yrs: payment = $38-42 vaccine cost; Part D Medicare so covered at the pharmacy or in office with pharmacy billing program (TransAct Rx)

• Annually 1.3% interns/residents contract pertussis; 3.6% of ED personnel by serology

• Duration of immunity following Tdap in question; pertussis biology may be changing

• For unvaccinated after a dirty wound 1 of 3 doses = Tdap
Vaccine Challenges for Adults

• Herpes zoster: killed vaccine: 2 doses; 95% effective; coming soon!
• Clostridia difficile: US 453,000 cases; 15,000 deaths
  https://www.cdc.gov/media/releases/2015/p0225-clostridium-difficile.html
• Staphylococcus aureus
• Respiratory syncytial virus: US 77,000 hospitalizations: 14,000 deaths among adults age ≥65 years
  https://www.cdc.gov/rsv/research/us-surveillance.html
• Dengue fever: vaccine effective in Central America /elsewhere
• Zika
• Ebola
• Malaria
• Cytomegalovirus
• HIV
• Tuberculosis
• Cancers: pancreatic cancer
How to Keep Up

• Get an app for the iPhone or Android
  o CDC app:  
    https://www.cdc.gov/vaccines/schedules/hcp/schedule-app.html
  o Society of Teachers of Family app: Shots
    iPhone go to: stfm.org/shots then scroll down and download
    Online go to: http://www.immunizationed.org/
  o American Academy of Family Physicians full services app (may soon contain Shots)
• Identify your favorite immunization resource
• Use online computer or electronic health record
• Use Immunization Action Coalition web site
• Subscribe to MMWR online email
  https://www.cdc.gov/mmwr/index.html
• Watch CDC, Immunization Action Coalition, National Foundation for Infectious Disease webinars
Shots Immunizations

Available for:
  iPhone, Android, Tablets, PCs

**FREE download from your app store**
  Search STFM, download Shots Immunizations
STFM: stfm.org/shots, scroll down then download best version for your device

Shots Online
  via internet connection for PCs, iPhones and tablets www.Immunizationed.org

Comprehensive information
Format makes information easy to find
Updated yearly when CDC publishes new schedules and whenever every new ACIP recommendation
Many residency directors and medical schools recommend or require the app for their students/residents
Topics Covered

- Basics
- High Risk Indications
- Adverse Reactions
- Contraindications
- Catch-up
- Administration
- Risk Communication
- Epidemiology
- Brand Names of Vaccines, CPT Codes
- Excipients (Additives)
- Pictures of vaccine preventable diseases
- Resident Education
**DTaP: Basics**

**Diphtheria, Tetanus, and acellular Pertussis/Diphtheria, Tetanus (DTaP/DT) – Vaccine Basics**

**Minimum age: 6 weeks**

**Childhood Schedule:**

- The primary 3 dose series is given at ages 2, 4, and 6 months.
- The fourth (booster) dose of DTaP may be administered at age \( \geq 12 \) months, provided 6 months have elapsed since the third dose. However, the fourth dose of DTaP need not be repeated if it was administered at least 4 months after the third dose of DTaP.
- Administer the fifth (final) dose in the series at
# Shots Immunizations

<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>
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<tbody>
<tr>
<td>HepB &gt;</td>
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<tr>
<td>MMR &gt;</td>
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<td></td>
<td></td>
<td>See Note &gt;</td>
<td>ProQuad &gt;</td>
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<tr>
<td>Rota &gt;</td>
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<td></td>
<td></td>
<td>1st dose</td>
<td>2nd dose</td>
<td>see note &gt;</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>DTaP &gt;</td>
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<td></td>
<td></td>
<td></td>
<td>1st dose</td>
<td>2nd dose</td>
<td>3rd dose</td>
<td></td>
<td>4th dose</td>
<td></td>
<td>5th dose</td>
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<tr>
<td>PCV &gt;</td>
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<td></td>
<td></td>
<td>1st dose</td>
<td>2nd dose</td>
<td>3rd dose</td>
<td></td>
<td>4th dose</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>IPV &gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1st dose</td>
<td>2nd dose</td>
<td></td>
<td>3rd dose</td>
<td></td>
<td></td>
<td></td>
<td>4th dose</td>
</tr>
<tr>
<td>Flu &gt;</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>Annual (IIV only) 1 or 2 doses</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>HepA &gt;</td>
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<td>Series &gt;</td>
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<td>MCV4 &gt;</td>
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<tr>
<td>PPSV &gt;</td>
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<td></td>
<td>See Note &gt;</td>
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</tr>
</tbody>
</table>

Full screen as viewed on tablet
Shots Immunizations

Hepatitis B Vaccine (HepB) – Basics

Recommended routinely for:

- All unvaccinated children and adolescents.
- All unvaccinated adults at risk for HBV infection (especially illicit drug users, men who have sex with men (MSM), and adults with multiple sex partners).
- All unvaccinated adults with diabetes mellitus aged 19-59 years (category A recommendation).
- All unvaccinated adults with diabetes mellitus aged ≥60 years at discretion of treating clinician (category B recommendation).
- All adults seeking protection from HBV infection.

Childhood Schedule

- Minimum age: birth for first dose.
- At least 3 doses; the minimum interval between doses 1 and 2 is 4 weeks, between doses 2 and 3 is 8 weeks and between doses 1 and 3 is 16 weeks.
- For standing orders in newborn units see http://www.immunize.org/catg.d/p2130.pdf

Birth dose: use only monovalent HepB for all newborns weighing ≥ 2,000 gms (4.4 lbs)

- Administer monovalent HepB to infants born to hepatitis B surface antigen (HBsAg) negative mothers prior to hospital discharge and count vaccination as part of series.
- If mother is HBsAg-positive, administer HepB and 0.5 mL of hepatitis B immune globulin (HBIG) in different sites within 12 hours of birth.
- If mother’s HBsAg status is unknown, within 12 hours of birth administer HepB for infants weighing ≥ 2000 grams. Determine mother’s HBsAg status as soon as possible and, if HBsAg-positive, administer HBIG (0.5 mL) for infants weighing ≥ 2000 grams (no later than age 1 week).

(See CDC for additional details http://www.cdc.gov/mmwr/PDF/rr/rr5416.pdf and http://www.cdc.gov/hepatitis/hbv/)

For preterm infants weighing < 2,000 gms (4.4 lbs), birth dose of monovalent HepB only may be delayed

- Small premature infants respond less well to HepB.
- With HBsAg-negative mother:
Immunization Action Coalition
Good Sites for Information

- CDC: https://www.cdc.gov/vaccines/index.html
- Email: nipinfo@cdc.gov for questions
- Shots Immunization 2017 (updated annually + prn)
  - For iPhones: itunes.apple.com
  - For Androids: play.google.com
- Shots by STFM 2017 Online
  - www.immunizationed.org/shotsonline.aspx
- Immunization Action Coalition: has everything!
  - www.immunize.org