Immunizations

1. Which of the following children should have their immunization delayed?
   A. 6-month-old child with a resolving otitis media on antibiotics
   B. 5-year-old child due to receive MMR and varicella whose mother is breast feeding
   C. 15-month-old with pneumonia
   D. 12-year-old on nasal steroids for asthma

Vaccines and Quality

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Immunizations

- Immunization is the most cost-effective form of health care delivery
- Most vaccines are 85-100% effective at preventing disease
- More Americans die from vaccine-preventable diseases than from breast cancer, HIV/AIDS, or MVAs

Learning Objectives

1. Describe the immunization schedule from newborns to octogenarians
2. Detect and recognize the common complications and contraindications of various vaccines
3. Discuss the latest vaccines and updates of older vaccines by the ACIP
Can Vaccinate *

- Nonanaphylactic reactions
- Local reaction
- Mild acute illness*
- Antimicrobial therapy*
- Resolving illness
- Disease exposure
- Pregnant household contacts*
- Low dose topical, oral, nasal, or intra-articular corticosteroids*

- Prematurity
- Breast feeding**
- FH seizures
- FH SIDS
- FH adverse reactions
- Allergies
- Multiple vaccines simultaneously

- In infants and children give vaccine in anterolateral thigh, adults in deltoid*
- A SERIES DOES NOT NEED TO BE STARTED OVER**

Contraindications and Precautions

- All vaccines are contraindicated if there was a previous anaphylactic reaction to any vaccine component
- There is a precaution for all vaccines if the individual has a moderate to severe illness

Immunization Schedule 0-6 Years

Immunization Schedule 7-18 Years

Catch-up Schedule (Minimum Time Between Doses)

Adult Immunization Schedule
**Adult Special Indications**

- Hepatitis B
  - 2nd leading cause of cancer worldwide
  - 90% infected as infants develop chronic disease
  - All children 0-18, young adults* and adults at high risk
  - All diabetics (not on test yet)
  - Adverse effects: local pain / swelling (10-20%)
  - 0, 1-2, 6 months (minimum age for 3rd dose is 24 wk)
  - Delay for premature infants until > 2 kg
  - Engerix-B or Recombivax HB (may give 2 doses 4- months apart for ages 11-15)
  - Infants born to HBsAg + mothers:
    - Vaccine and HBIG within 12 hours of birth
    - Check HBsAg at 9-18 months

**2. Which of these children should receive the rotavirus vaccine?**

A. 6 ½-week-old infant whose mother is in for her postpartum check
B. 4-month-old infant who missed his 2-month check up
C. 9-month-old infant who has already received 2 doses of vaccine
D. 4-month-old infant who just vomited his second dose

21%  59%  8%  12%

**Rotavirus**

- 3 million cases, 600,000 deaths worldwide annually
- Live, attenuated, oral vaccine
  - RotaTeq (RV5) oral doses 2, 4, 6, months (use if latex allergic)
  - Rotarix (RV1) oral doses 2 and 4 months
- Do not repeat “spit out” or vomited dose*
- Dosing schedule:
  - 1st dose must be given between 6 and < 15 weeks of age (previously 12 wks)
  - Full series completed by 8 months (previously 32 wk)*
  - Minimum interval—4 wk*

**Hepatitis B**

- Side effects: vomiting and diarrhea, no increase in intussusception
- Contraindication: severe combined immune deficiency
- Precautions:
  - Delay vaccine for moderate to severe gastroenteritis
  - Spina bifida
  - History of intussusception*
  - Other altered immunity
- Infants living with pregnant women or with immunosuppressed individuals may be immunized.
Diptheria/Tetanus/Pertussis

- DTaP for all doses < age 7
  - 2, 4, 6, 18 months, 4-6 yrs
  - Last 2 doses must be 6 mo after previous dose
- Tdap is booster at age 11-12
  - Minimum age Boostrix 10, Adacel 11
  - If not protected can give ages 7-9
  - Can now give at any age*—recommended if in contact with small children No minimum interval after Td
  - Give prior to pregnancy, after 20 wk, immediately after pregnancy
- Every 10 years after Tdap
- Never vaccinated: 0, 1, 7 months*

Contraindication
- Encephalopathy within 7 days of previous dose

Precautions
- Progressive neurologic disorder*, seizures, high fever, GBS (< 6 wk after prior dose)

Adverse reactions
- Fever, fussiness, local reaction, seizures, hypotonic-hyporesponsive reaction

Tetanus

- Treat pertussis with azithromycin or clarithromycin.
  - Trimeth/sulfa is 2nd line
- Contagious 5 days on antibiotics or 3 weeks without

Polio Vaccine (IPV)

- Polio eradicated from the western hemisphere in 1994
- In 1954, 18,000 cases of paralytic polio
- Inactivated vaccine (IPV) recommended for all doses
  - 2, 4, 6-18 months, 4-6 yrs
  - Last dose must be after 4 years of age (even if 4 doses were previously given)
  - Last dose must be 6 mo after prior dose
  - Use of Pentacel means 5 doses will be given
  - DTaP/IPV (Kinvix) can be used for dose at 4-6 years

Hemophilus Influenza B

- H. flu caused invasive disease in 1:200 infected
- Schedule
  - Primary series at 2, 4, 6 months
  - Booster at 15 months
  - If 1st dose given > 12 mo, give 2 doses 8 wk apart
  - Only one dose needed after 15 months
  - Not usually given ≥ 5 years
- Adverse reactions: local pain, fever
- Recall children who missed their 15-month booster

Combination Vaccines

- Pediarix (commonly used): DTaP – IPV – HepB
- Pentacel: DTaP – IPV – Hib (may be less effective for Native American and Alaskan children)
- Kinrix: DTaP – IPV (for 4-5 year old booster)
- Twinrix: HepA – HepB (only for ≥ 18 years)
- Convax: Hib – HepB
- TriHiBit: Hib – DTaP
- ProQuad: MMRV (increased seizure risk)

Streptococcus Pneumoniae

- S. pneumoniae causes:
  - 19,000 preventable deaths per year (pneumonia, bacteremia, meningitis)
  - 7 million cases of otitis media per year
- Polyvalent vaccine
  - 23 serotypes that cause 80% of invasive pneumococcal disease in U.S.
  - B-cell response
  - 96% drop in pneumonia caused by susceptible strains
  - PCV-13 (replaces PCV-7)
    - T-cell response
## Pneumococcal Vaccine

**Prevnar-13**
- Decreases hospitalizations, costs, and invasive disease
- Schedule same as PCV-7
- Primary series 2, 4, 6 months, booster 12-15 months
- Catch-up: first dose at
  - 7-11 months: give 2 doses and booster 8 wks later
  - 12-23 months: 2 doses 8 wks apart
  - 2-5 years: one dose for healthy, unvaccinated children
  - 2-5 years: two doses 8 weeks apart for at-risk children
- Children 14-59 months give additional dose of PCV-13
- Children 14-71 months at-risk give additional dose PCV-13

## Children at Risk
- Chronic cardiac disease (especially cyanotic congenital and failure)
- Cirrhosis, chronic liver disease, alcoholism
- Cochlear implants, Cerebrospinal fluid leak
- Diabetes*
- Chronic lung disease (asthma treated with high-dose oral steroids)
- Chronic renal disease (renal failure, nephrotic syndrome)
- Asplenia, sickle cell*
- Immunocompromised (HIV, congenital, drugs, or radiation)

### 3. 2-year-old female with sickle cell anemia has just finished her PCV series. When should she receive a PPV vaccine?

A. Any time after age 2 years  
B. At least 4 weeks after her last PCV  
C. At least 8 weeks after her last PCV  
D. PPV should not be given in children

### 4. Which of the following children should not receive the MMR vaccine?

A. Parents of the child are worried about autism  
B. Child has a fever of 38º and a mild cough  
C. Mother is pregnant  
D. Child received varicella vaccine last week
4. Which of the following children should not receive the MMR vaccine?

- A. Parents of the child are worried about autism (4%)
- B. Child has a fever of 38° and a mild cough (24%)
- C. Mother is pregnant (44%)
- D. Child received varicella vaccine last week (32%)

MMR Vaccine
- Live attenuated vaccine, given SQ
- Give at 12-15 mo and 4-6 yr
- Everyone born after 1956 needs 2 doses
- Vaccinate health care workers born < 1957
- 1st dose doesn’t count if given < 1 yr of age
- Give with varicella or 28 days apart
- MMRV: use at ages 4-6
  - Increases rate of febrile seizures at age 1, but can use
- Adverse effects: fever, rash, arthralgias
- Contraindications:
  - Severe immune deficiency (HIV with CD4+ count < 200/μliter),
  - Pregnancy (within 28 days)
  - Within 3-11 months of immune globulin
- Does not lead to autism and single doses not available

Varicella
- 1st dose > 12 months, booster at 4-6 years
- 4 weeks apart if > 13 yr; 3 months apart < 13 yr
- May be administered with MMR or 28 d apart
- May be used as prophylaxis if given within 3-5 d
- Contraindications:
  - Altered immunity (can give in HIV disease if CD4 count > 200 μliter)
  - Pregnancy
- Adverse effects: rash, fever; rarely: pneumonia; zoster
- Immunization of 12-15 month old children with varicella vaccine and catch-up immunization of children to 12 years with varicella vaccine (A).
- Immunization of susceptible adolescents and adults with varicella vaccine (B)
  - http://www.canadiantaskforce.ca/docs/CTF_Varicella_TR.pdf

Hepatitis A
- 270,000 cases decreased to 40,000 with vaccine
- 2 different vaccines
  - Havrix for ages ≥ 2 yr
  - Vaqta for ages ≥ 1 yr (not available)
- 2 doses 6-12 months apart
- All children aged 12-23 months, recommended for all up to age 18, adults if high risk or requested
- Other indications
  - International travelers to all but a few countries*
  - Chronic liver disease or chronic hepatitis
  - Drug users
  - Males having sex with other males
  - Close contact with an international adoptee*
- Post-exposure prophylaxis: vaccine for healthy 1-40 year olds; all others should receive immune globulin

Influenza Vaccine
- 100,000 hospitalizations, 20,000 deaths/year
- Patients > 65 = 80-90% of deaths
- Contraindications:
  - Everyone over 6 months of age
  - Pregnant women any trimester (not the live vaccine)**
- Immunization of children and adolescents provides “herd” immunity but only if using the live attenuated (LAIV) nasal form

Influenza Vaccine Dosage
- Types of vaccines
  - FluZone: 6 months and older
  - Fluvirin: 4 years and older
  - Fluarix: 18 years and older
  - Flulaval: 18 years and older
  - *FluMist (intranasal-LAIV): Healthy 2-49 years*
  - H1N1 now included in vaccine
- LAIV cannot be used in:
  - Pulmonary or cardiovascular disease
  - History of Guillain-Barré
  - Pregnancy
  - Long-term aspirin or salicylate therapy*
  - Children 2-4 yrs who have wheezed in last year*
  - Egg allergy

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5. Which of the following is only effective for Influenza A?

A. Oseltamivir (Tamiflu)
B. Zanamivir (Relenza)
C. Amantadine
D. LAIV (intranasal vaccine)

6. Which of the following should be offered to college freshmen planning on residing in the dormitory?

A. Pneumococcal vaccine
B. Inactivated polio vaccine
C. Hemophilus influenza vaccine
D. Meningococcemia vaccine

Meningococcemia

- 2600 cases/year, death rate 10%
- Minimum age 2 years
- MPSV4 (Menomune) preferred for ages ≥ 56
- MCV4 (Menactra) T-cell dependent for ages 2-55
- Contraindications
  - Anaphylaxis to diphtheria toxoid
  - Severe reaction to latex
  - Guillain-Barré
- Exposure (family and close contacts):
  - Chemoprophylaxis with rifampin* 600 mg q 12 hours for 2 days (can use cipro or minocycline in adults)
- New for at-risk ages 9 mo and 1 yr (not on boards)
**Meningococccemia**

- Recommended for:
  - College freshmen living in dormitories* (revaccinate with MCV4 if received MPSV4 > 5 years ago)
  - CDC has recommended for all adolescents at 11-12 yr or entering high school; catch-up for all ages 13-18 yr
  - Booster at ages 16-18 yr if given before age 15
  - If given at ≥ 16 yr does not require a booster
  - Children ages 2-10 and adults with terminal complement deficiencies or anatomic or functional asplenia (2 doses)
  - Microbiologists
  - Military recruits and travelers to high-risk areas
  - If still at risk and had MPSV4, 2nd dose in 3 years (1st dose age 2-6 yr) or in 5 years (1st dose age ≥ 7 yr) with MCV4

**Human Papillomavirus Vaccine**

- Not the first cancer vaccine, hepatitis B was the 1st
- Two products
  - HPV4, contains strains 6, 11, 16, 18 (cervical ca, warts)
  - HPV2, product strains 16, 18 (cervical ca only)
- Strains 16 and 18 cause 70-80% of cervical cancer
- Pain, swelling at injection site, fainting (watch 15 min)
- Contraindications: allergy to yeast (HPV4), latex (HPV2)
- Given IM at 0, 2, and 6 months (at least 24 wks after 1st, 12 wks after 2nd)
- Recommended for 11-12 year olds
- Give ages 9-26 even if previously exposed
- May give in males 9-18 years of age (cost effectiveness will depend on herd immunity)

**Zoster Vaccine**

- One dose of herpes zoster (HZ) vaccine at ≥ 60 years (FDA at 50)
- No upper age limit but better if given younger
- Reduce outbreaks by 51%
- Greatest benefit is reduction in postherpetic neuralgia by 66.5%
- Can be given to patients with prior zoster infection as soon as the infection clears
- Contraindications
  - Immunodeficiency or high-dose corticosteroids (20 mg/d ≥ 2 wk)
  - Active-untreated TB
  - Pregnancy
- Stored frozen—may not be out of the freezer > 30 min

**Adolescent Health Visit: 11-12 Yr**

- Tdap*
- MCV4 (Menactra)*
- HPV
- Influenza yearly
- Catch-up
  - Hepatitis B if not already given or finished
  - MMR
  - Varicella
  - IPV (polio)
- High-risk
  - Pneumococcal
  - Hepatitis A

**Health Care Workers**

- 2 doses MMR
- 2 doses Varicella
- 3 doses Hepatitis B
- Yearly flu vaccine
- 1 dose Tdap

**Vaccines not Used in Pregnancy**

- Live vaccines contraindicated
  - MMR (measles, mumps, rubella)
  - Varicella
  - LAIV (live attenuated intranasal flu vaccine)
  - Zoster
  - Yellow fever
- Precaution for:
  - Hepatitis A
  - HPV (human papilloma virus)
  - IPV (inactivated polio vaccine)
  - MCV4 (no data)
Immediately Postpartum

- If not previously vaccinated with the following vaccines
  - Tdap (if \( \geq \) 2 years since last dT dose)
  - Influenza if still during flu season*
  - MMR if not rubella-immune
  - Varicella if 2 doses not received

Rabies

- Recommended for vets, animal handlers, exposure
- Pre-exposure: Days 0, 7, and 21 or 28
- Post-exposure: Days 0, 3, 7, 14 and immune globulin
- Adverse reactions: local, nausea, headache, abdominal pain
- Likely transmission from: bats, raccoons, and skunks
- If awakened and bat is in the room, must vaccinate

Smallpox

- Multiple-puncture technique with bifurcated needle
- Papule in 3-5 days
- Vesicle in 5-8 days
- Pustule in 8-10 days
- Contagious until scabbed
- www.cdc.gov/mmwr

Typhoid

- Not recommended for use in U.S. Given for travelers to Latin America, Asia, and Africa.
- Oral form: 4 capsule take every other day
  - Complete 1 week prior to departure
  - Only for those \( \geq \) age 6
- IM form: single dose (0.5 mL)
  - Must give \( \geq \) 2 weeks prior to departure
  - Ages \( \geq \) 2 years

Malaria

- See CDC website for areas of resistance and further info concerning medication choices
- Atovaquone-proguanil: well tolerated
  - 1-2 prior to travel to 7 days after return
- Chloroquine and Mefloquine
  - Weekly 2 weeks before until 4 weeks after
  - Can be used throughout pregnancy
- Doxycycline
  - Daily 1-2 days before until 4 weeks after
- Primaquine: Most effective
  - Daily 1-2 days before to 7 days after

Conclusion

- JUST REMEMBER: VACCINATE

- Websites: www.cdc.gov/vaccines
  www.immunize.org

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Answers

1. C
2. A
3. C
4. D
5. C
6. D