Immunization Review and 2018 Updates

Kara Schrader, DNP, NP-C
Assistant Professor, Health Programs
Michigan State University College of Nursing

May, 2018

Learning Objectives

- Review rationale for routine vaccination
- Review current trends in vaccine preventable illnesses
- Update practitioners regarding immunization recommendations and 2018 changes
- Access and utilize resources to assist in preventing vaccine preventable illnesses
Number of Diseases Prevented by Vaccines Included in the Routine Child/Adolescent Immunization Schedule

- **1964 (6)**
  - Smallpox
  - Polio
  - Diphtheria
  - Pertussis
  - Tetanus
  - Measles
  - Rubella
  - Mumps

- **1985 (7)**
  - Polio
  - Diphtheria
  - Pertussis
  - Tetanus
  - Measles
  - Rubella
  - Mumps
  - Hib

- **1995 (10)**
  - Polio
  - Diphtheria
  - Pertussis
  - Tetanus
  - Measles
  - Rubella
  - Mumps
  - Hib
  - HepB
  - Varicella

- **2018 (16)**
  - Polio
  - Diphtheria
  - Pertussis
  - Tetanus
  - Measles
  - Rubella
  - Mumps
  - Hib
  - HepB
  - HPV
  - Hep A
  - Chickenpox
  - Influenza
  - Meningococcal
  - Rotavirus

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**Polio**

- Many variations of the vaccine over the years
  - Inactivated polio vaccine (IPV)
  - Oral polio vaccine (2 types)
  - Oral Polio vaccine (3 types)
  - Oral discontinued 2000 (US)

- Current IPV
  - 3 doses of IPV thought to be 99% effective, 4 doses recommended
  - 2 months, 4 months, 6-18 months, 4 years
  - Duration unclear
  - Often in combination

CDC, 2015, CDC, 2018
Diphtheria

**Basics**
- Bacterial toxin spread by respiratory droplets
- Diphtheria infections classified according to location
- Toxin if absorbed: myocarditis, neuritis, respiratory failure, renal failure
- As of 2017, only 5 cases reported in US
- Death rate 5-10%
- Treatment: antibiotics

**Prevention**
- Immunization
  - Primary series 2, 4, 6, 15-18 months, 4-6 years
  - DTaP, DT, Td, Tdap ("d" diphtheria booster, "D" primary diphtheria series), given IM
  - After primary series: 95% effective
  - Booster every 10 years

CDC, 2015; CDC, 2018

Pertussis (AKA: “whooping cough”)

**Basics**
- *Bordetella pertussis* bacteria
- Incidence has increased since 1980s
- Pertussis resurgence of childhood disease despite high DTaP coverage
- Respiratory transmission, the young infants most at risk for complications/death
- Cough, severe fatigue, pneumonia, dehydration, seizures

**Prevention**
- Excellent initial vaccine effectiveness (98%)
- Switch to acellular pertussis vaccines is changing epidemiology
- Moderate and immediate waning of immunity
- 70% effective 5 years after receiving the 5th dose
- Re-emergence of adolescent disease
- Tdap effectiveness 73% within 1 year of vaccination; 34% 2 to 4 years post vaccination
- Waning immunity driving disease incidence

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CDC, 2015; CDC, 2018

Td/Tdap not currently covered by Medicare Part B
Diphtheria, tetanus, acellular pertussis (DTaP) primary series
• Typically 5 dose series given with diphtheria and tetanus toxoid
• 2, 4, 6 and 15-18 months, 4-6 years
• No 5th dose if 4th was given after age 4
• If given ≤ 4 days earlier than interval recommended, vaccine is still valid
• Only indicated for children less than 7 years
• DT can be given (up to age 7) but only if pertussis component contraindicated

Tetanus, diphtheria, acellular pertussis booster (Tdap)
• Adolescents 11-12 years
• If 7-10 years and did not receive full primary series, give Tdap, then Td every 10 years
• All pregnant women 3rd trimester
• All adults, 1 x dose if no documentation of receiving since 2005
  • Especially if going to be around infants/children
• Tetanus, diphtheria (Td) every 10 years after Tdap
• Adacel® age 10-64  Boostrix® age 10 and over

Haemophilus influenza type B

Basics
• Bacterial infection, illness most severe in infants
• Prior to vaccine: leading cause of bacterial meningitis and epiglottitis in kids under age 5
• Nasopharyngeal transmission
• Vaccine approved 1987

Prevention
• Primary series begins at 2 months (not before 6 weeks)
• PedvaxHIB®: 3-dose series at 2, 4, and 12–15 months
• ActHIB®, Hiberix®, or Pentacel®: 4-dose series at 2, 4, 6, and 12–15 months.
• 1 approved for booster for 12 months and older (Hiberix®)
• 95% effective after primary series
• Need to follow specific CDC guidelines if behind in schedule
Measles
*Highly contagious, viral illness
*High fever, rhinorrhea, cough
*Rash later sign
*Pneumonia, diarrhea, dehydration
*Prior to vaccine, over 90% of the children in US had history of measles infection by age 15 (500 deaths per year)

Mumps
*Viral infection
*Transmitted respiratory droplets→nasopharynx →lymph nodes
*Becomes widespread and inflammatory (pancreas, testes, ovaries, meninges)
*Parotitis, orchitis
*Sensorineural hearing loss with meningitis

Rubella
*Viral infection
*Itchy rash, enlarged lymph nodes, joint pain, arthritis, encephalitis
*Pregnant women with illness very serious
**Congenital rubella syndrome
Deafness, severe ophthalmic disorders, cardiac malformations, microcephaly

Number of Measles Cases by Year

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<td>2017</td>
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<td>2018</td>
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Number of Mumps Cases by Year

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<td>2017</td>
<td>5629</td>
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<td>2018</td>
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*As of February 24, 2018
MMR Vaccination

- Combo vaccine only
- MMR between 12-15 months
- MMR with varicella age 4-6 years (MMRV)
- 99% effective with after 2 doses
- Life-long immunity
- Very low risk for reaction due to egg allergy
- Contraindicated:
  - Pregnancy (4 weeks prior, during, 4 weeks post-partum)
  - Severely immunosuppressed
- Absolutely no evidence to support MMR as cause of autism

Hepatitis B virus (HBV)

- **Basics**
  - Transmitted mucus membranes, body fluids
  - Most common transmission in US maternal-fetal, and sexual contact
  - 94% decline in acute Hep B since routine vaccination in 1990s
  - Little decline in chronic Hep B
  - Recently higher rates of acute Hep B due to opioid epidemic
  - Up to 90% of infants who acquire HBV infection from their mothers at birth become chronically infected; 25% fatality rate
  - If infected between 1-5 years, 30-50% HBV becomes chronic
  - High risk of hepatocellular cancer with chronic HBV
Hepatitis B Virus

**Prevention**
- 3 dose series for children
- Monovalent within 24 hours of birth (Energix-B®, Recombivax HB®)
- 1-2 months, 6-18 months
- Pediarix® combo often used for doses other than newborn dose
  - Hep B, DTaP, IPV 2, 4, 6 months
  - OK for 4th dose of Hep B
  - Only approved up to age 7
  - Adolescents needing vaccination receive monovalent (Recombivax HB®)
  - Not used for 5th dose
- Twinrix®: combo Hep B and Hep A
  - 18 years
  - 3 dose series

Rotavirus

**Basics**
- Very contagious, fecal-oral route transmission
- Diarrhea, dehydration, electrolyte imbalance
- Before vaccine, caused 30-50% hospitalizations for viral gastroenteritis ≤5 years with 20-60 deaths per year
- Vaccine recommended 2006
- Continued sporadic outbreaks in childcare centers

**Prevention**
- Rotavirus vaccine 1 (RV1, Rotarix®)
  - 2 dose series
  - Oral 2 and 4 months
- Rotavirus vaccine 5 (RV5, Rotateq®)
  - 3-dose series
  - Oral 2, 4, 6 months
  - If dose previously received is unknown or Rotateq®, give Rotateq®
  - Do not begin series after 14 weeks and 6 days
  - Last dose in series max age 8 months
  - Effectiveness 78-89%
  - Low rate of vaccine completion (73%)
Varicella primary

❖ Basics

• Herpesvirus, can stay dormant after first infection
• Fever, pruritic rash→vesicles
• Typical lifetime immunity (from primary) if healthy
• Highest risk of complication: Immunocompromised, infants, fetal exposure shortly prior to delivery and up to 2 days after (high fatality rate)
• Death rates decreased 88% since vaccine recommendation 1995 (1 dose)
• Continued infection (less severe) 2001-2005, 2nd dose recommended 2006
• Infection rates declined total 97% with 2nd dose

CDC, 2015, CDC, 2018

Primary varicella: “chickenpox”

❖ Prevention

• Monovalent vaccine (Varivax®) licensed in 1995
• Quadrivalent: MMRV (ProQuad®) licensed in 2005
  • MMRV is approved 12 months-12 years
• Both are live “attenuated”
• 2 dose series (can give even with prior history of infection)
  • 12-15 months, 4-6 years
  • Best to give 1st separate as individual vaccines (MMR and varicella)
  • 2nd dose recommended to be combo MMRV
• Catch up (with no hx of disease)
  • 7-12 years: 2 dose varicella, 3 months apart
  • 13 years and older: 2 doses 4-8 weeks apart
• Estimated to be 70-90% effective against infection, though 90-100% effective from getting severe disease

CDC, 2010; CDC, 2015, CDC, 2018
Varicella zoster “shingles”

基础知识

- 再激活带状疱疹病毒沿神经路径
- 85岁之前，50%的人将发展出疱疹
- 感染并发症
  - 后带状疱疹神经痛
  - 眼部神经损伤
- 最易发生严重并发症的人群
  - 免疫抑制
  - 胎儿暴露
  - 初次带状疱疹时的年轻年龄

CDC, 2015, CDC, 2018

Varicella Zoster

预防

- 第一个疫苗于2006年批准使用，Zoster Vaccine Live (ZVL)，Zostavax®
  - 适用于50岁及以上的年龄组，推荐60岁及以上
  - 含相同的活弱化病毒，与水痘和MMRV疫苗相同，但含有更高剂量
  - 1剂系列
  - 1年后（年龄依赖）保护力下降38-70%
  - 不需要确认初次带状疱疹的历史
  - 禁用免疫抑制者
    - 预地松＞20 mg超过2周
    - 当前使用免疫调节剂、生物制剂
    - 白血病、淋巴瘤、HIV、当前化疗或放射治疗

CDC, 2015, CDC, 2018
Varicella Zoster, continued

- **Prevention:** New vaccine recommendation Feb 2018
  - Recombinant zoster vaccine (RZV) Shingrix®
    - Approved for ages 50 and older
    - 2 dose series, 2-6 months apart
    - Effective 85-96% after 3 years (age dependent)
    - Give even if received HZV or has history of zoster
    - No need to confirm history of primary varicella
    - Preferred over ZVL
    - Reactogenicity-can last 2-3 days
      - Hyperactive immune response
      - Pain or redness at the site, headache and shivering
      - More common in adults under the age of 70

Neither zoster vaccine covered by Medicare Part B. Is covered by Part D and many other insurance drug plans

Zostavax®: $213   Shingrix®: $280

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Streptococcus pneumoniae

- **Basics**
  - 80 different serotypes
  - Most common cause of pneumonia in children/adults and 50% of all cases of bacterial meningitis in kids under 5
  - Cause of most cases of otitis media in children under 5
  - Most common cause of bacteremia, 20-60% fatality rate
  - Before pneumococcal conjugate vaccine, 200 deaths in children per year
  - Highest risk of complicated pneumococcal pneumonia
    - Adults with cancer (blood cancers)
    - Immunocompromised (primary or secondary)
    - Chronic heart disease, renal disease, pulmonary disease (asthma, COPD), liver disease
    - Absence of spleen
    - Smokers
    - Hx of cochlear implant
  - Managed with antibiotics: resistance a problem
  - Vaccination has evolved since 1977

Centers for Medicare and Medicaid Services, 2018; CDC, 2018; Umanski, 2018
**Streptococcus pneumoniae (continued)**

- **Pneumococcal conjugate vaccine 13 (PCV13, Prevnar®)**
  - **Children**
    - Replaced PCV7 in 2010
    - Primary series: 2, 4, 6 months, 12-15 months,
    - Different schedule if not vaccinated before 7 months (see CDC catch-up schedule)
    - If child 14-59 months received 4 doses of PCV7, give 1 PCV13 dose
  - **Adults**
    - Approved for ages 50 and older
    - 1 dose age 65 recommended
    - Give 1 year before PPSV23 (if not already received)
    - High risk adults may receive sooner

Both pneumonia vaccines covered by Medicare Part B

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**Prevention:** Important to be aware and educate that these vaccines do not cover non-bacteria causes of pneumonia

- Polysaccharide vaccine (PPSV23) Pneumovax®
- 23 types of pneumococcal bacteria that cause 60-76% severe illness
- Adults: once under 19-64 if:
  - Chronic conditions: liver, renal, pulmonary (asthma, COPD), diabetes
  - Smokers and history of smoking
  - Alcoholism
- All adults at or after age 65
  - 1 year after pneumococcal conjugate vaccine (PCV 13)
  - 5 years after previous dose of PPSV23 (if given)
- Children with high risk conditions: 2-18 years (see CDC special conditions schedule)
Bacterial Meningitis

**Basics**
- *Neisseria meningitidis*: leading cause of bacterial meningitis in US
- 13 strains, most infections in US caused by A, B, C, W, Y
- Droplet respiratory transmission → multiply in mucosa of nasopharynx and spread
- Crosses blood-brain barrier to CSF → sepsis (meningococcemia)
  - Up to 40% fatality rate if sepsis
- Persons at risk
  - Adolescents
  - Crowded, close quartered housing
  - Recent viral URI
  - Military recruits
  - Active and passive smoke
  - Occupation in labs working with bacteria
  - Infants/children/adults with certain medical conditions
- First vaccine in 1974 (A, C, W, Y), though current quadrivalent vaccine, 2005

Bacterial Meningitis

**Prevention**
- Meningococcal MCV-4: serogroups A,C,W,Y (Menactra® or Menveo®)
  - Approved for infants, children and adults with high risk conditions
  - Routine vaccination with first dose at age 11-12, booster at age 16
  - If first dose given at age 16 or older: 1 dose, no booster needed
  - Many universities/colleges requiring proof of vaccination within 5 years
- Meningococcal serogroup B (Bexsero® and Trumenba®)
  - Patient/provider/parent choice, this year became listed on MICR
  - Age 16-23 years, preferred 16-18 years
  - Bexsero®: 2 doses at least one month apart
  - Trumenba®: 3 doses (0, 1-2 months, 6 months apart)
  - Use same brand for all doses
  - More reactogenic causing injection site pain, low grade fever, headache (up to 7 days)
- Can give both MCV-4 and Men B at same time and with other vaccines

CDC, 2015; CDC, 2017; CDC, 2018;
Human Papillomavirus (HPV)

- **Basics**
  - HPV most common STD in the US
  - 40 different types
  - Infection with HPV causes
    - Cervical, vaginal, vulvar cancers in women (types 16 and 18)
    - Penile cancer in men (types 16 and 18)
    - Oral and anal cancers in both men and women (types 16 and 18)
    - Genital warts in both men and women (types 6 and 11)
  - Study released 12/2017: 10 years since HPV4 vaccination pre-adolescent and adolescents
    - Maintained +antibodies after 10 years with highest in those that received vaccine between 9-12 years
    - No cases of HPV 16,18 related cancers, genital warts or precancers after 10 years when vaccinated early (preadolescent and adolescent)
    - 3 infections (no cancer) occurred in those vaccinated 30 months later (placebo group)
    - Some vaccinated acquired other high risk HPV infection (not in the HPV4 vaccine)

- **Prevention**
  - Screening in not prevention
  - Best to vaccinate before sexual activity
  - 9vHPV (Gardasil 9®)
    - Approved to give as early as 9 years in high risk populations (hx of sexual assault)
    - Routine recommendation for males or females aged 11-12 years
    - 2 doses sufficient if given before age 15
    - 0, 6-12 months
    - If age 15 or older, 3 dose series recommended (0,1-2 months, 6 months)
    - If 4vHPV started the series, complete with the 9vHPV
    - Can begin series up to age 26, men or women. Once started, can complete after age 26
    - Give despite history of sexual activity or if HPV+ testing or condyloma
  - Many studies and surveys support provider recommendation as having the most influence in acceptance of vaccine
  - CDC, 2018; Meites et al, 2016)
Hepatitis A (HAV)

**Basics**
- Primarily fecal-oral transmission, contaminated food/water
- Aug 2016-May 2018: 828 outbreak related cases, 665 hospitalized, 26 deaths
- Most at risk
  - Persons living or traveling to regions of high rates
  - Men who have sex with men (MSM)
  - Close contact with infected person
  - IV/non IV drug users
  - Those with clotting disorders
- Started in SE Michigan and spreading throughout state
- No common food/restaurant source discovered

**Prevention:** Routine vaccination and post-exposure prophylaxis during outbreaks
- Havrix®
  - 2 doses, 6-12 months apart
  - Pediatric dose (720 ELISA units) approved **12 months-18 years**
  - Adult dose (1440 ELISA units) approved **19 years and older**
- VAQTA®
  - 2 doses, 6-18 months apart
  - Pediatric dose (25 units) approved **12 months-18 years**
  - Adult dose (50 units) approved **19 years and older**
- One dose 90-95% effective within 1 month
- Twinrix®: Combo vaccine (HBV, HAV)
  - Approved for 18 years and older for those not vaccinated for HBV
  - 3 dose schedule: 0, 1, 6 months
  - Contains peds. dose of Hep A antigen
  - Not for outbreaks

**Post-exposure prophylaxis**
- Referral to local HD
- 12 months to 40 years: 1 dose Hep A vaccine (Not combo)
  OR
  - Hep A IG within 2 weeks (dose dependent on age)
- <12 months, 40 years and older: Hep. A IG: infants Hep A IG: Immunocompromised, chronic liver and renal disease

**Priority Vaccination Population During Outbreak**
- IVDU and non-IV illicit DU
- MSM
- Homeless
- Incarcerated or recently incarcerated
- Acute or chronic liver disease
- Travelers/workers to endemic countries
- Clotting factor recipients
- Unvaccinated who have close person contact
Impact of Pentacel and Quadracel vaccines on the immunization schedule

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<th>6 MONTHS</th>
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Dose 1: Diphtheria, tetanus, and acellular pertussis.
Dose 2: Haemophilus influenza type b
Dose 3: Pneumococcal polysaccharide
Dose 4: Influenza (yearly)
Dose 5: Hepatitis A (2-dose series)

PEDIARIX helps maintain your well-established primary series DTaP routine

PEDIARIX has been the foundation of GSK’s DTaP-containing vaccine portfolio since 2002.

- **PEDIARIX as a primary series:** Three doses of 0.5 mL each, by intramuscular injection, at 2, 4, and 6 months of age (at intervals of 6 to 8 weeks, preferably 8 weeks). The first dose may be given as early as 6 weeks of age (prior to the 7th birthday).
- **According to the Centers for Disease Control and Prevention (CDC):** Administration of a total of 4 doses of hepatitis B vaccine is permitted when a combination vaccine containing hepatitis B is administered after the birth dose.
- **A 3-dose series of PEDIARIX may be administered to infants born of HBsAg-negative mothers and who received a dose of hepatitis B vaccine at or shortly after birth. However, data are limited regarding the safety of PEDIARIX in such infants.”
Immunization Training for Clinicians

- **You Call the Shots**: Web-based modules that discuss vaccine-preventable diseases (VPDs) and explain the latest recommendations for vaccine use. CE/CME credit offered.
- **Current Issues in Immunization Net Conference (CIINC)**: Live 1-hour audio and visual presentations with on-demand replays. Offered 4-5 times per year. CE/CME credit offered.
- **Pink Book Webinar Series**: Online series of 15 1-hour webinars. Provides an overview of the principles of vaccination, general recommendations, immunization strategies for providers, and specific information about VPDs and vaccines. CE/CME credit offered.
- **Webcasts**: Topics include HPV, pertussis, flu, vaccine storage and handling, and more. CE credits offered.

Links to resources

Listing of approved vaccines brands in the US as of 12/2017


List of vaccines that may contain latex due to packaging:

Provider Resources for Vaccine Conversations with Parents

- Talking to Parents about Vaccines
- Understanding Vaccines and Vaccine Safety
  - How Vaccines Work
  - The Recommended Childhood Immunization Schedule
  - Ensuring the Safety of U.S. Vaccines
  - Understanding MMR Vaccine Safety
  - Understanding Thimerosal, Mercury, and Vaccine Safety
  - The Advisory Committee on Immunization Practices
- Diseases and the Vaccines that Prevent Them
- If You Choose Not to Vaccinate, Understand the Risk and Your Responsibilities

www.cdc.gov/vaccines/conversations
Childhood Immunization Materials to Share with Parents

www.cdc.gov/vaccines/parents/resources

Resources for adults

https://www.cdc.gov/vaccines/adults/resources.html

https://www2.cdc.gov/nip/adultimmsched/
References