Rachel C. Orscheln, MD
The Importance Of Pediatric Immunizations
April 16, 2015
Once upon a time, there was a Magic Kingdom....
Children and families from all over the world visited this magical place....
Unfortunately, an unwelcome visitor was also circulating...

Measles Virus

Index Case

• 11 y.o. unvaccinated child who had visited 2 theme parks in Orange County, CA was hospitalized with measles in December of 2014
Measles

- **Measles**: RNA virus with 1 serotype
  - **Transmission**: By direct contact with respiratory droplets
  - **Epidemiology**: Incidence in the US is low, <120 cases/year, usually imported
  - **Illness**: Acute illness characterized by:
    - Fever
    - Cough
    - Runny nose
    - Conjunctivitis
    - Erythematous maculopapular rash
    - Koplik spots
  - **Complications**: pneumonia, otitis media, croup, diarrheal, encephalitis (1/1000 cases), death (1-3/1000 cases), SSPE (rare degenerative CNS disease)
  - **Treatment**: Vitamin A supplementation is associated with reduced morbidity and mortality

*Redbook, 2006*
Confirmed Measles Cases by Date of Onset
Measles Cases by State and Year

Most cases had **NO** documented measles vaccine

- **California cases:**
  - 45% were completely unvaccinated
    - 67% intentionally unvaccinated for personal belief
    - 23% were too young to be vaccinated
  - 5% had one dose of measles vaccine
  - 7% had two or more doses of measles vaccine
  - 43% unknown vaccine history

- Twenty percent of patients were hospitalized
2015 Measles Cases in the U.S.
January 1 to April 3, 2015

*Provisional data reported to CDC's National Center for Immunization and Respiratory Diseases*
Source case thought to be international traveler

• Strain identical to measles strain causing large outbreak in the Philippines

Philippines outbreak 2014

– 58,010 suspected cases
– 21,420 confirmed cases (110 deaths)
– 25 returning travelers to the US with measles

*Preliminary data as of May 23, 2014
Source: National Notifiable Diseases Surveillance System (NNDSS) and direct report to CDC
2014 Outbreak

• 23 Outbreaks of Measles in the US in 2014
• Largest outbreak in Amish community in Ohio affects 383 people
  – Index case is Amish missionary who traveled to the Philippines
Measles in the Philippines

2014
58,010 suspected cases
21,420 confirmed cases
110 deaths

Legend:
- No confirmed case
- With confirmed case
- No case based data

1 dot = 1 case

Dots are placed at random within the corresponding district, and might not reflect the exact location of the case.
The Moral of the Story

“It’s a small world after all!”
Objectives

• Review basic vaccinology
• Understand the concept of “herd immunity”
• Review infections prevented by vaccinations and the impact of vaccination programs on these diseases
• Examine controversies related to vaccinations and vaccine refusal
Introduction

• Vaccines are among the most effective preventative health tools
• The success of vaccination programs depends on high rates of uptake
• High immunization coverage results in a decline in vaccine-preventable diseases
• A reduction in these diseases may result in increased complacency about vaccine-preventable diseases

How Vaccines Work

• Weakened or part of a germ is injected
• The immune system recognizes the germ as a “foreign invader” (called antigen) and forms immune proteins (antibodies) to the germ
• If the body faces the real germ in the future, the pre-formed antibodies are prepared to attack and prevent infection

Adapted from: http://www.cdc.gov/vaccines/vac-gen/howvpd.htm
## Specific Types of Vaccines

<table>
<thead>
<tr>
<th>Type of Vaccine</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live-attenuated</td>
<td>Weakened virus which does not cause disease</td>
<td>MMR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Varicella</td>
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<td></td>
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<td>Flu</td>
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<tr>
<td>Inactivated</td>
<td>Inactivated (killed) virus</td>
<td>Polio</td>
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<tr>
<td>Toxoid</td>
<td>Weakened toxin from bacteria</td>
<td>Tetanus</td>
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<tr>
<td>Subunit</td>
<td>Contains part of bacteria or virus</td>
<td>Pertussis</td>
</tr>
<tr>
<td>Conjugate</td>
<td>Target polysaccharide (sugar-like) coating on bacteria by connecting (conjugating) them to antigens the developing immune system can recognize</td>
<td>Pneumococcal</td>
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<tr>
<td></td>
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<td>HiB</td>
</tr>
</tbody>
</table>
If I don’t vaccinate my child, won’t they be protected by “Herd Immunity”?
Herd Immunity

“The resistance of a group attacked by a disease because of the immunity of a large proportion of the members and consequent lessening of the likelihood of an infected individual coming into contact with a susceptible individual.”

Herd Immunity

- **Determinants**
  - $R_0$ = The average number of individuals each infected person will infect in susceptible population
  - $1 - 1/R_0$ = The proportion needed to vaccinate to eliminate infection
  - $E$ = vaccine effectiveness
  - $(1 - 1/R_0)/E$ = critical vaccine coverage
  - Measles
    - $(1 - 1/12)/0.95 = 96$

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Herd Immunity

= not immunized but still healthy

= immunized and healthy

= not immunized, sick, and contagious

No one is immunized.

Contagious disease spreads through the population.

Some of the population gets immunized.

Contagious disease spreads through some of the population.

Most of the population gets immunized.

Spread of contagious disease is contained.
# Recommended Immunization Schedule for Persons Aged 0 to 18 Years

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Birth</th>
<th>1 mo</th>
<th>2 mos</th>
<th>4 mos</th>
<th>6 mos</th>
<th>9 mos</th>
<th>12 mos</th>
<th>15 mos</th>
<th>18 mos</th>
<th>19-23 mos</th>
<th>2-3 yrs</th>
<th>4-6 yrs</th>
<th>7-10 yrs</th>
<th>11-12 yrs</th>
<th>13-15 yrs</th>
<th>16-18 yrs</th>
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</thead>
<tbody>
<tr>
<td>Hepatitis B (HepB)</td>
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<tr>
<td>Rotavirus(^2) (RV) RV1 (2-dose series); RV6 (3-dose series)</td>
<td>1(^{st}) dose</td>
<td>2(^{nd}) dose</td>
<td>See footnote 2</td>
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<tr>
<td>Diphtheria, tetanus, &amp; acellular pertussis(^1) (DTaP; &lt;7 yrs)</td>
<td>1(^{st}) dose</td>
<td>2(^{nd}) dose</td>
<td>3(^{rd}) dose</td>
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<tr>
<td>Tetanus, diphtheria, &amp; acellular pertussis(^1) (Td; ≥7 yrs)</td>
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<tr>
<td>Haemophilus influenza type b(^1) (Hib)</td>
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<tr>
<td>Pneumococcal conjugate(^6) (PCV13)</td>
<td>1(^{st}) dose</td>
<td>2(^{nd}) dose</td>
<td>See footnote 5</td>
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<tr>
<td>Pneumococcal polysaccharide(^1) (PPSV23)</td>
<td>1(^{st}) dose</td>
<td>2(^{nd}) dose</td>
<td>3(^{rd}) dose</td>
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<tr>
<td>Inactivated poliovirus(^2) (IPV) (&lt;18 yrs)</td>
<td>1(^{st}) dose</td>
<td>2(^{nd}) dose</td>
<td>See footnote 5</td>
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<tr>
<td>Influenza(^8) (IIV; LAIV); 2 doses for some: See footnote 8</td>
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<td>Annual vaccination (IIV only)</td>
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<td>Measles, mumps, rubella(^8) (MMR)</td>
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<td>Annual vaccination (IIV or LAIV)</td>
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<td>Varicella(^10) (VAR)</td>
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<td>Hepatitis A(^11) (HepA)</td>
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<tr>
<td>Human papillomavirus(^2) (HPV2: females only; HPV4: males and females)</td>
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<td>Meningococcal(^13) (Hib-MenCY ≥ 6 weeks; MenACWY-D ≥9 mos; MenACWY-CRM ≥ 2 mos)</td>
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</tbody>
</table>

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* Not routinely recommended

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Range of recommended ages for all children

Range of recommended ages for catch-up immunization

Range of recommended ages for certain high-risk groups

Range of recommended ages during which catch-up is encouraged and for certain high-risk groups

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Hepatitis B Virus

• Transmission: Contact with blood or body fluids

• Disease state:
  – Acute: Liver dysfunction with fever, jaundice, malaise, nausea, vomiting, and abdominal pain
  – Chronic: Duration of infection dependent on age at acquisition (90% of infants vs. 5% of adults)
  – Outcome:
    • Cirrhosis or liver cancer occurs in 25% of chronic childhood infections and 15% of chronic adult infections

http://www.cdc.gov/hepatitis/HBV/HBVfaq.htm#overview
Hepatitis B Virus

- Vaccine: 3 doses (birth, 1 month, and 6 months)
- Vaccine efficacy:
  - Infants: 95% develop protective immunity
  - Adults < 40 years: 90% develop protective immunity

http://www.cdc.gov/hepatitis/HBV/HBVfaq.htm#overview
Redbook, 2006.
http://www.dpd.cdc.gov/vaccines/pubs/pinkbook/hepb.html#reactions
Rotavirus

- Transmission: Fecal-oral
- Disease: Fever, vomiting, watery diarrhea (3-8 days), abdominal pain
- Epidemiology:
  - Most common cause of severe diarrhea among children
- Vaccine: Live, oral, 2 or 3 doses
- Efficacy: 85-98% effective against severe disease

http://www.cdc.gov/rotavirus/
Diphtheria

- **Diphtheria:** Caused by toxigenic strains of *Corynebacteria diphtheriae*
  - Transmission: Respiratory droplet or contact with skin lesions
  - Illness:
    - Membranous nasopharyngitis or obstructive laryngotracheitis
    - Absorbed toxin affects heart and brain
  - Treatment: Anti-toxin, erythromycin or penicillin
  - Outcome:
    - Death in 1 in 10

http://www.cdc.gov/vaccines/vpd-vac/diphtheria/photos.htm

Redbook, 2006
Diphtheria Epidemiology

Diphtheria Hotspots 1997 - present; cases reported to the WHO

♦ Over 100 reported cases
♦ Between 50 and 100 reported cases
♦ Between 1 and 49 reported cases
♦ No cases reported

Tetanus

• Tetanus: Caused by bacterium *Clostridium tetani*
  – Transmission: Contamination of wounds
  – Illness:
    • Generalized tetanus (Lockjaw): Neurologic disease with severe muscle spasms
    • Localized tetanus: Localized muscle spasms
  – Treatment:
    • Wound and supportive care
    • Tetanus immune globulin
    • Antibiotics
  – Outcome:
    • Death in 1 in 5

Pertussis

• Pertussis: Caused by *Bordetella pertussis*
  • Transmission: Respiratory droplets
  • Illness: Respiratory tract illness in phases:
    • Catarrhal: cold symptoms
    • Paroxysmal: paroxysms of cough followed by inspiratory whoop and vomiting
    • Convalescent: symptoms wane over weeks to months
    • Apnea and sudden death in infants without many other symptoms

• Treatment:
  • Supportive care
  • Antibiotics: Macrolide antibiotics

• Outcome:
  • Pneumonia in 1 in 4
  • Encephalopathy in 1 in 300
  • Death in 1-2 in 100

http://www.co.dakota.mn.us/Departments/PublicHealth/News/Nov08.htm

Redbook, 2006
Pertussis Epidemiology

Reported NNDSS pertussis cases: 1922-2012*

*2012 data are provisional.

SOURCE: CDC, National Notifiable Diseases Surveillance System and Supplemental Pertussis Surveillance System and 1922-1949, passive reports to the Public Health Service

http://www.cdc.gov/pertussis/about/complications.html
Pertussis and Vaccine Refusal

- Evaluated the relationship between Non-medical exemptions (NME) and pertussis outbreaks
  - Geocoded NME for vaccination for schools during the 2005-6 through 2009-10 school years
  - Geocoded confirmed, probable, and suspected cases of pertussis in 2010
• From 2000 to 2010 NME rates tripled
• NME as high as 84% in some schools
• >95% vaccine coverage rate is necessary for prevention of outbreaks
• Clusters of pertussis outbreaks overlapped significantly with areas with high rates of NME
Diphtheria, Tetanus, Pertussis

- Vaccine recommendations: 5 doses (2, 4, 6, 15-18 mos, and 4-6 years)
  - Tdap booster at 11 years
  - Tdap with pregnancy

- Efficacy:
  - Tetanus 100%
  - Diphtheria 95%
  - Pertussis 80-85%

Redbook, 2006.
**Haemophilus influenzae type B**

- **Transmission:** Respiratory droplet or direct contact with respiratory secretions
- **Disease states:**
  - Pneumonia
  - Sepsis
  - Meningitis (8-10K cases/year)
  - Epiglottitis
  - Bone and joint infections
  - Cellulitis
  - Otitis media
- **Treatment:** Antibiotics
- **Outcome:**
  - Death in 3-6%
  - Permanent disability in 30% of meningitis
- **Vaccine:** 3 or 4 doses
- **Efficacy:** 95-100%

*Rate per 100,000 children age <5 yrs*

Redbook online accessed 4/2015
http://www.cdc.gov/hi-disease/clinicians.html
**Streptococcus pneumoniae**

- **Transmission:** Respiratory droplet
- **Disease states:**
  - Otitis media (most common)
  - Sinusitis
  - Pneumonia
  - Meningitis
  - Skin and eye infections
  - Bone and joint infections
- **Treatment:** Antibiotics
- **Vaccine:** 4 dose series
- **Efficacy:** > 90% against invasive disease
Poliovirus

• Viruses: Enteroviruses of 3 serotypes, 1, 2, and 3
• Transmission: Fecal-oral and respiratory
• Disease states:
  – 95% of infections are asymptomatic
  – 4-8% non-specific illness with fever and pharyngitis
  – 1-5% aseptic meningitis
  – 0.1-2% asymmetric acute flaccid paralysis with areflexia of the affected limb (2/3 will have residual paralytic polio)

• Vaccine: 4 dose series
• Efficacy: 99-100%

http://www.cdc.gov/vaccines/pubs/pinkbook/polio.html

Redbook, 2006
Influenza

- Viruses:
  - Influenza A: Subtyped based on 2 surface proteins
    - Hemaglutinin (16 subtypes)
    - Neuraminidase (9 subtypes)
  - Influenza B
- Transmission: Respiratory droplets
- Illness: “The Flu”
  - Fever
  - Headache
  - Fatigue
  - Myalgias
  - Cough
  - Sore throat
  - Congestion
  - Gastrointestinal complaints
- Treatment: Antivirals
- Complications on Influenza:
  - Bacterial pneumonia
  - Ear and sinus infections
  - Asthma exacerbation
- Yearly influenza mortality:
  - 3,000-49,000 deaths per year in the US
  - Up to 350 pediatric deaths each year

http://www.cdc.gov/flu
Influenza

- Vaccines:
  - Inactivated influenza vaccine (IIV), trivalent and quadrivalent
  - Live-attenuated influenza vaccine (LAIV4), quadrivalent
  - Recommendations: Yearly vaccine (2 doses for first year if < 9 years)

- Vaccine efficacy depends on:
  - Host status
  - Match of vaccine to strains
  - Type of vaccine given:
    - LAIV > IIV
  - 50-90% when strains well-matched

http://www.cdc.gov/mmwr/preview/mmwrhtml/rr6207a1.htm?__cid=rr6207a1_w#Tab1
Mumps

- Mumps: RNA virus
  - Transmission: Respiratory secretions
  - Epidemiology: <300 cases/year
  - Illness:
    - Swelling of the glands
    - Meningitis
    - Orchitis
  - Treatment: Supportive care
  - Outcome:
    - Death is rare
    - Deafness in 1 in 20,000
    - Sterility in post-pubertal males (rare)

Redbook, 2006
Rubella

- Rubella: RNA virus
  - Transmission:
    - Respiratory droplet
    - Congenital infection
  - Epidemiology:
    - Before vaccine: epidemic disease
    - Post-vaccine: <25 cases/year (99% reduction in incidence)
  - Illness (aka German measles or 3-day measles)
    - Fever
    - Rash
    - Arthritis
    - Lymphadenopathy
    - Rarely: Encephalitis or low platelet count
    - Congenital rubella syndrome

Redbook online accessed 4/2015.
MMR

- Vaccine: MMR is a live, attenuated, 3 component vaccine
- Vaccine recommendations: 2 doses (12-15 mos and 4-6 years)
- Efficacy: 99% for Measles and 95% for Mumps and Rubella

http://www.cdc.gov/vaccines/pubs/pinkbook
Varicella

• Virus: Varicella-zoster virus of the herpesvirus family
• Transmission: Airborne spread or by direct contact
• Illness:
  – Chicken pox
  – Shingles
• Epidemiology: Pre-vaccine era, most infections occurred in children <10 years
  – 1/500 children hospitalized
  – 1/50 adults hospitalized
  – 1/100,000 children died
    • Pneumonia
    • Bacterial superinfection
    • Hepatitis
    • Encephalitis

• Treatment: supportive and antivirals for certain patients

Redbook, 2006
Varicella

- Vaccine: Varicella vaccine is a live-attenuated virus vaccine
- Vaccine recommendations: 2 doses (12-15 mos and 4-6 years)
- Efficacy:
  - Prevents chicken pox in 70-90%
  - Prevents severe varicella in 95%

http://www.dpd.cdc.gov/vaccines/pubs/pinkbook/varicella.html#
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5653a1.htm

Varicella Reported by year for 4 States
Hepatitis A Virus

- Transmission: Person-to-person by fecal-oral route
- Epidemiology: Prior to vaccination, approximately 20,000 cases/year in the US with 100 deaths
- Disease:
  - Asymptomatic in young children
  - Acute hepatitis with fever, malaise, jaundice, anorexia, and nausea
  - Fulminant hepatitis may occur but is rare
- Treatment: Supportive care
- Vaccine: 2 doses
- Efficacy: 94-100%

Redbook, 2006
http://www.cdc.gov/vaccines/npd-vac/hepa/downloads
Meningococcus

- *Neisseria meningitidis*: Gram-negative bacterial infection with at least 13 serogroups
- Transmission: Person-to-person through respiratory droplets.
- Epidemiology:
  - Peak occurrences:
    - < 5 years of age (peak attack rate age < 1 year)
    - Adolescents 15-18
  - Freshman college students in dorms have higher rates than non-college students

http://www.cdc.gov/vaccines/pubs/pinkbook/mening.html#epi
Redbook, 2006
Meningococcus

- Disease states:
  - Asymptomatic colonization is common
  - Invasive infections:
    - Meningococcemia: Abrupt onset of fever, chills, malaise, prostration, and rash
    - Meningococcal meningitis
- Treatment: Antibiotics and supportive care
- Vaccines: 2 dose series for routine vaccination at age 11 and 16 years
Human Papillomaviruses

• Epidemiology:
  – Anogenital HPV is most common STD (occurring in >40% of sexually active females)

• Disease states:
  – Clinically unapparent infection → Cervical dysplasia
  – Cervical cancer (12,000 cases/year with 4000 deaths)
  – Penile cancer
  – Head and neck cancer
  – Anogenital warts
  – Respiratory tract papillomatosis

• Vaccines: Inactivated subunit
  – Bivalent- HPV 16 and 18
  – Quadrivalent- HPV 6, 11, 16, 18

http://www.cdc.gov/vaccines/pubs/pinkbook/hpv.html
Summary- Part 1

• Diseases prevented by vaccination are serious
• Most of these infections continue to be in transmission in the US
• Vaccinations are an effective strategy to prevent these diseases
• Herd immunity provides an additional layer of protection, especially for the most vulnerable
Are vaccines safe?

- Minor side effects are possible for all vaccines: pain, redness, tenderness at the site of injection
- Serious side effects are uncommon and unlikely to be permanent
  - Pertussis vaccine: crying, high fever, febrile seizure
  - Hepatitis B vaccine: anaphylaxis in 1 in 600,000
Are vaccines safe?

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Adverse Event</th>
<th>Odds</th>
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<tbody>
<tr>
<td>Measles</td>
<td>Pneumonia</td>
<td>6 in 100</td>
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<tr>
<td></td>
<td>Encephalitis</td>
<td>1 in 1,000</td>
</tr>
<tr>
<td></td>
<td>Death</td>
<td>2 in 1,000</td>
</tr>
<tr>
<td>MMR</td>
<td>Encephalitis or severe allergic reaction</td>
<td>1 in 1,000,000</td>
</tr>
<tr>
<td>Living in the US</td>
<td>Lightning strike</td>
<td>1 in 960,000</td>
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<tr>
<td>Walking</td>
<td>Dying</td>
<td>1 in 54,538</td>
</tr>
</tbody>
</table>

### Recommended Immunization Schedule for Persons Aged 0 to 18 Years

- **Hepatitis B (HepB):**
  - 1st dose
  - 2nd dose
  - 3rd dose

- **Rotavirus (RV):**
  - 1st dose
  - 2nd dose
  - 3rd dose

- **Diphtheria, tetanus, & acellular pertussis (DTaP);**
  - 1st dose
  - 2nd dose
  - 3rd dose

- **Tetanus, diphtheria, & acellular pertussis (Tdap);**
  - 1st dose
  - 2nd dose
  - 3rd dose

- **Haemophilus influenzae type b (Hib):**
  - 1st dose
  - 2nd dose
  - 3rd dose

- **Pneumococcal conjugate (PCV13):**
  - 1st dose
  - 2nd dose
  - 3rd dose

- **Pneumococcal polysaccharide (PPSV23):**
  - 1st dose
  - 2nd dose
  - 3rd dose

- **Inactivated poliovirus (IPV);**
  - 1st dose
  - 2nd dose
  - 3rd dose

- **Influenza (IIV; LAIV);**
  - 1st dose
  - 2nd dose
  - Annual vaccination (IIV only)

- **Measles, mumps, rubella (MMR);**
  - 1st dose
  - 2nd dose

- **Varicella (VAR);**
  - 1st dose
  - 2nd dose

- **Hepatitis A (HepA);**
  - 1st dose
  - 2nd dose

- **Human papillomavirus (HPV):**
  - 1st dose
  - 2nd dose

- **Meningococcal (Hib-MenCY;**
  - 1st dose
  - 2nd dose

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**Range of recommended ages for all children**

**Range of recommended ages for catch-up immunization**

**Range of recommended ages for certain high-risk groups**

**Range of recommended ages during which catch-up is encouraged and for certain high-risk groups**

**Not routinely recommended**
# 1970 Recommended US Childhood Immunization Schedule

| Range of recommended age |  
|----------------------------|--------------------------------------------------|--------------------------------|
| **Vaccine**                | **Birth** | **1 mo** | **2 mos** | **4 mos** | **6 mos** | **12 mos** | **15 mos** | **18 mos** | **24 mos** | **4-6 yrs** | **11-12 yrs** | **13-18 yrs** |
| Diphtheria, tetanus, pertussis | DTP       | DTP       | DTP       |           |           | DTP         |           |           | DTP         | OPV         |           | Td           |
| Oral polio                 | OPV       | OPV       | OPV       |           |           |             |           |           |             | OPV         |           |              |
| Measles                    |           |           |           | Measles   |           |             |           |           |             |             |           |              |

Adapted from Centers for Disease Control and Prevention (CDC).
Do vaccines overwhelm the immune system?

– The immune system is primed *in utero* to respond to antigens

– The neonate is challenged with multiple antigens from the moment of birth

Do vaccines overwhelm the immune system?

– The immune system can respond to billions of antigens
  • 10,000,000 B-cells are present in every mL of blood
  • Each B-cell can produce enough new B-cells to make an effective vaccine response (10 ng/mL of antibody) in one week
  • Vaccines in use today contain between 1 and 70 antigens per vaccine

– If 11 vaccines were given all at once, this would temporarily use only 0.1% of this arm of the immune system

Do vaccines overwhelm the immune system?

- Current vaccines have fewer antigens than older vaccines

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</table>

- Vaccines contain far less antigens than any natural infection

Do vaccines cause Autism?
What is Autism?

• Developmental disorder with the following characteristics:
  – Social impairments
  – Communication difficulties
  – Restricted, repetitive, and stereotyped patterns of behavior
  – Most often identified in toddlers from 18 to 30 months of age

What is the cause of Autism?

- Genetics
  - Twin studies show increased concordance with identical twins
  - Increased risk if sibling is affected
  - Parents and siblings of autistic children often exhibit mild traits on sensitive testing
  - Males affected at a rate of 4:1 compared to females

Do vaccines cause Autism?

• The Wakefield Study:
  – 1998- Dr. Andrew Wakefield published paper describing 12 children with bowel symptoms and developmental disorders that he linked to the MMR vaccine.
The Wakefield Study

- Wakefield was paid by lawyer seeking to sue vaccine manufacturers for 2 years prior to study (total sum paid $750,000)
- Most patients in the study were contacts of lawyer (not sequentially presenting patients as presented)
- Wakefield was seeking patent on mono-valent measles vaccines at the same time

The Wakefield Study

• Data was fabricated when compared to actual patient medical records
  – Onset of developmental concerns was altered to fit timing after MMR
    • 5/12 had pre-existing developmental concerns
    • Developmental symptoms were reported to have occurred within days of MMR, but records showed concerns months later
  – GI symptoms developed after diagnosis of autism in 4/12 patients
  – Abnormal pathological findings reported by Wakefield were actually normal

• Paper was retracted and Wakefield lost his license to practice medicine
Vaccines are not the cause of Autism!

• Developmental disorders are diagnosed in childhood and vaccines are given during childhood

• Multiple studies in the US and Europe have found no association between the MMR and autism
Vaccines are not the cause of Autism!

• Multiple studies demonstrate NO LINK between MMR and autism:
  – 59 studies between 2004-2011
  – 14,700,000 children
  – Multiple countries
Vaccines are not the cause of Autism!

- Home movie studies:
  - Review of home videos of 1st B-day
  - Blinded comparison of children with autism to typically developing children
  - Investigators can identify autistic children (pre-diagnosis)
  - MMR is typically given AFTER 1st birthday

Vaccines are not the cause of Autism?

- Reported rates of autism may have increased
  - Change in diagnostic criteria
  - Increased awareness
  - Increased availability of services
- Rates of vaccination have been stable
Do vaccines contain unnecessary additives?

- Vaccines contain preservatives and additives to keep the product sterile and increase efficacy
- The amount of chemical additives is small
  - Aluminum salts:
    - Increase vaccine efficacy
    - Amount in vaccine = amount in 32 oz of infant formula
  - Formaldehyde:
    - Inactivates viruses and detoxifies bacteria
    - Amount in vaccine similar to what is naturally in the human blood stream

http://www.cdc.gov/vaccines/vac-gen/additives.htm
Do vaccines contain unnecessary additives?

- Polyethelene glycol:
  - Viral inactivator and vaccine purifier
  - Found in many household products like toothpaste

- Thimerosol
  - Mercury containing preservative
  - Metabolizes to ethylmercury (different from environmental neurotoxin methylmercury)
  - Numerous studies demonstrate NO LINK to developmental disorders
  - Thimerosol has been removed from pediatric vaccines

http://www.cdc.gov/vaccines/vac-gen/additives.htm
Does my child need vaccines if I breastfeed?

- Breastfeeding provides numerous benefits to health including reducing risk of disease:
  - Bacteremia
  - Diarrhea
  - Respiratory tract infection
  - Otitis media
  - Urinary tract infection
  - Late-onset sepsis in preterm infants
  - Necrotizing enterocolitis
  - Type 1 and type 2 diabetes
  - Lymphoma, leukemia, and Hodgkins disease
  - Childhood overweight and obesity

Does my child need vaccines if I breastfeed?

- Breastfeeding is insufficient protection against vaccine preventable diseases
- Breastfeeding and vaccinations work synergistically
  - Breastfeeding boosts immune responses to some vaccines
  - Breastfeeding is associated with a decreased pain response in infants
What About Delaying Vaccines?

• There is no benefit to delaying vaccines
• Delaying vaccines results in:
  – Increased window of vulnerability for the most vulnerable
  – Increased exposure to infectious diseases through increased number of office visits
  – Increased painful encounters

Summary

• Vaccines are among the most effective preventative health tools
• High rates of vaccination within a community result in protection for those who cannot be vaccinated
• When rates of vaccination fall, diseases reemerge
• Refusal of vaccination often results from misunderstanding regarding the benefits of vaccination